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N. 192

MINISTERO DELLE POLITICHE AGRICOLE
ALIMENTARI E FORESTALI

DECRETO 21 luglio 2011.

Approvazione del Piano di gestione per la pesca del rossetto nella GSA 9 in sostituzione del decreto direttoriale del 19 maggio 2011.

S O M M A R I O

MINISTERO DELLE POLITICHE AGRICOLE ALIMENTARI E FORESTALI

DECRETI, DELIBERE E ORDINANZE MINISTERIALI

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IL DIRETTORE GENERALE
DELLA PESCA MARITTIMA E DELL'ACQUACOLTURA

Visto il decreto legislativo 30 luglio 1999, n. 300, recante riforma dell'organizzazione del Governo a norma dell'art. 11 della legge 15 marzo 1997 n. 59 e successive modifiche ed integrazioni;

Visto il decreto legislativo 30 marzo 2001, n. 165 recante «Norme generali sull'ordinamento del lavoro alle dipendenze delle amministrazioni pubbliche»;

Visto il decreto del Presidente della Repubblica del 22 luglio 2009, n. 129 «Regolamento recante riorganizzazione del Ministero delle politiche agricole alimentari e forestali, a norma dell'art. 74 del decreto-legge 25 giugno 2008, n. 112, convertito, con modificazioni, dalla legge 6 agosto 2008, n. 133»;

Vista la legge 14 luglio 1965, n. 963, e successive modifiche, concernente la disciplina della pesca marittima;

Visto il decreto del Presidente della Repubblica 2 ottobre 1968, n. 1639, e successive modifiche, con il quale è stato approvato il regolamento per l'esecuzione della predetta legge;

Visto il decreto legislativo 26 maggio 2004, n. 154 concernente la «Modernizzazione del settore pesca e dell'acquacoltura, a norma dell'art. 1, comma 2, della legge n. 7 marzo 2003, n. 38»;

Vista il decreto del Presidente della Repubblica 22 luglio 2009, n. 129, recante la «Riorganizzazione del Ministero delle politiche agricole alimentari e forestali»;

Visto il decreto ministeriale 30 novembre 1999 recante la disciplina sulla pesca del rossetto (Aphia minuta) nei compartimenti marittimi della Toscana e della Liguria (GSA 9);

Visto il reg. (CE) del Consiglio del 21 dicembre 2006, n. 1967/2006 che istituisce «Misure di gestione per lo sfruttamento sostenibile delle risorse della pesca nel mar Mediterraneo e recante modifica del reg. (CEE) n. 2847/93 e che abroga il reg. (CE) 1626/94»;

Visto il decreto direttoriale del 27 dicembre 2010 che adotta il Piano nazionale di gestione delle attività esercitate con sistema a sciabica da natante e circuizione senza chiusura;

Visto in particolare l'art. 13 del suddetto regolamento n. 1967/2006 che consente agli Stati membri di chiedere una deroga ai divieti inerenti i valori minimi di distanza e profondità per l'uso degli attrezzi da pesca, quali la sciabica e la circuizione senza chiusura, a condizione che tale deroga sia giustificata da vincoli geografici specifici, qualora le attività di pesca non abbiano un impatto che esse non possano essere esercitate con altri attrezzi e rientrino in un piano di gestione ai sensi dell'art. 19 del regolamento stesso;

Visto il decreto direttoriale 19 maggio 2011, pubblicato nella *Gazzetta Ufficiale* della Repubblica italiana 5 luglio 2011, n. 154, recante Adozione del Piano di gestione per la richiesta di deroga alla distanza dalla costa per la pesca del rossetto (Aphia minuta) con la sciabica e la circuizione senza chiusura nella GSA 9;

Vista la nota n. D(2011)702329 del 29 giugno 2011 con cui la Commissione europea ha richiesto di apportare delle modifiche al suddetto Piano nazionale di gestione;

Preso atto delle richieste formulate dalla Commissione europea;

Ritenuto opportuno adottare il Piano di gestione, con il quale è richiesta la deroga alla distanza dalla costa per la pesca del rossetto (Aphia minuta) con la sciabica e la circuizione senza chiusura nella GSA 9, elaborato ai sensi degli articoli 9 e 13 del sopra richiamato Reg. (CE) 1967/2006, adeguandolo alle riferite richieste della Commissione europea in sostituzione del Piano di cui al citato decreto direttoriale 19 maggio 2011;

Decreta:

Art. 1.

1. È adottato il Piano di gestione per la richiesta di deroga alla distanza dalla costa per la pesca del rossetto (Aphia minuta) con la sciabica e la circuizione senza chiusura nella GSA 9 (All. *A)* in sostituzione del Piano nazionale di gestione di cui al decreto direttoriale 19 maggio 2011.

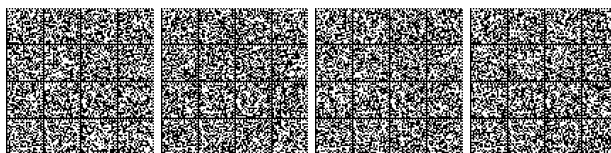
2. Il presente decreto sostituisce il decreto direttoriale 19 maggio 2011, recante Adozione del Piano di gestione per la richiesta di deroga alla distanza dalla costa per la pesca del rossetto (Aphia minuta) con la sciabica e la circuizione senza chiusura nella GSA 9, pubblicato nella *Gazzetta Ufficiale* 5 luglio 2011, n. 154.

Il presente provvedimento è trasmesso all'Organo di controllo per il visto di competenza ed è divulgato tramite la pubblicazione sulla *Gazzetta Ufficiale* della Repubblica italiana e sul sito internet www.politicheagricole.gov.it

Roma, 21 luglio 2011

Il direttore generale: ABATE

NATIONAL MANAGEMENT PLAN FOR DEROGATION TO MESH SIZE AND DISTANCE FROM THE COAST (RULE (EC) N. 1967/2006, ART. 9) AND 13) REGARDING THE USE OF BOAT SEINES FOR TRANSPARENT GOBY (APHIA MINUTA) FISHING IN GSA 9

MAY 2011

Introduction and objectives

Transparent goby, *Aphia minuta*, is a small goby having a maximum size of 6 cm. In Italy it is an important resource of small-scale fishing. It is usually caught in winter by small-scale fleets disseminated throughout the Ligurian Sea (Relini *et al*., 1998), Tyrrhenian Sea (Auteri *et al.*, 1998), Adriatic Sea (Ungaro *et al*., 1994; Froglia *et al*., 1998) and Sardinia (Cau, 2000).
Other Mediterranean areas where the species is commonly caught are the Balearic Islands and the continental coast of Spain (Iglesias and Morales-Nin, 2001).
Transparent goby is fished along the GSA 9 with seine. This type of activity is a thriving business since the species is considered quite tasty.
This is why many fishermen tend to direct their winter fishing to the catching of this species, substituting the traditional gear commonly used for fishing throughout the rest of the year.
Considering the importance of this resource and its exploitation, appropriate technical measures for management must be laid down in order to preserve and protect this fish species over time and preserve this particular fishing technique involving the use of gear that belongs to the history, traditions and culture of the local fishing communities.
While drawing the plan it must also be taken into account that for those small scale fishermen authorized to catch transparent goby, this species represent a large percentage of their yearly income, often reaching more than 60% of the total income.
This document is meant as a scientific basis for an adequate management of this resource. The document is based mainly on a precautionary approach to managing this resource which requires permanent monitoring by gathering scientific information steadily throughout time. The content of this study summarize the most up to date information used to evaluate the current situation of the above-mentioned fishing activity which has been documented in detail in the past 20 years and which can be assumed to be a stable and sustainable situation according to the management criteria detailed below.

Furthermore, the present document aims at outlining the guidelines and preliminary fishery regulation policies for the purpose of protecting and maintaining a long-lasting use of this resource and the biological, economic and social sustainability of fishing.
The objectives which this management plan expects to reach by identifying the following measures are:
- Maintenance of historical small-scale fisheries and subsequent adoption of appropriate management measures to ensure and maintain the trade of such fishing.
- Monitoring the state of exploitation by determining the amount of each catch, fishing effort and the basic biological parameters.
- Identification of a set of indicators needed to verify both the state of exploitation and the effectiveness of the management measures taken.
- should the stock need a recovery setting up pre-negotiated management responses agreed with the fishermen to reduce the fishing effort.

CHAPTER 1 – GENERAL INFORMATION

1.1 Legislation fundaments

Below are listed the details of the Italian legislation -- in descending order from the more recent to the less recent –concerning the fishing of transparent goby.
This list is not expected to be exhaustive.
- Note by Dir. Gen. Pesca of MIPAAF of 19/01/2009 (PEMAC 0001411) - Authorization for transparent goby fishing in the Maritime District of Liguria and Tuscany.
- Ministerial Decree of 22/12/2008 - Authorization for professional fishing of pilchard and transparent goby juveniles in the in-shore waters of all Maritime districts, excluding the Maritime district of Manfredonia, from 30 January to 30 March 2009
- Note of Dir. Gen. Pesca of MIPAAF of 08/01/2007 (PEMAC 0000483) - Transparent goby fishing in the Maritime district of Liguria and Tuscany.
- Ministerial Decree of 30/01/2007 - Regulations on the fishing of pilchard (*Sardina pilchardus*) and transparent goby (*Aphia minuta*) juveniles for the year 2007. Official Gazette No. 34 of 10 February 2007
- Ministerial Decree of 12/1/2004 - Authorization for professional fishing of pilchard (*Sardina pilchardus*) and transparent goby (*Aphia minuta*) juveniles for the year 2004. Publication details: Official Gazette No. 15 of 20/1/2004
- Ministerial Decree of 8/1/2003 - Determination of the period in which the fishing of pilchard and transparent goby juveniles is allowed for the year 2003. Publication details: Official Gazette No. 14 of 18/1/2003
- Ministerial Decree of 11/1/2002 - Regulation of professional fishing of marine juveniles for human consumption and transparent goby for the year 2002. Publication details: Official Gazette No. 15 of 18/1/2002
- Ministerial Decree of 14/3/2001 - Modifications of terms pursuant to Ministerial Decrees 20 December 2000 and 12 January 2001 established for the exercise of professional fishing of pilchard, anchovy and transparent goby juveniles. Publication details: Official Gazette No. 69 of 23/3/2001
- Ministerial Decree of 13/2/2001 - Amendments to the fishing regulation of marine juveniles for human consumption and transparent goby. Publication details: Official Gazette No. 52 of 3/3/2001
- Ministerial Decree of 20/12/2000 - Exercise of professional fishing of pilchard, anchovy and transparent goby juveniles for the 2001 fishing campaign. Publication details: Official Gazette No. 301 of 28/12/2000
- Ministerial Decree of 23/11/1999 - Exercise of professional fishing of pilchard, anchovy and transparent goby juveniles for the 2000 fishing campaign. Publication details: Official Gazette No. 284 of 3/12/1999
- Ministerial Decree of 12/11/1998 - Regulation of professional fishing of pilchard, anchovy and transparent goby (Aphia minuta) juveniles. Publication details: Official Gazette No. 287 of 9/12/1998

According to Ministerial Decrees of 20/12/1985, 1/12/1989 and 18/11/1992, the daily catch report forms were distributed and filled out by each fisherman for each day of activity. The survey is still in progress. These forms contain all the information regarding the boat, the shipbuilder, the day of reference, the fishing location and the quantities of transparent goby caught. Moreover the forms also report the quantities of bycatches, if any.
Thanks to the use of these forms a large amount of information has been gathered. The longest time series and the most detailed data have been gathered in Tuscany, where the time series start in 1989, allowing for the construction of a large database with which to develop a historical analysis and determine the models to use to carry out the management directives.
Starting from these information, the contents of this document derive from the monitoring and analysis of the professional fishing of transparent goby along the Tuscan coast in the past 20 years.
In particular, based on Law No. 41 of 17.12.1982, the Italian Ministry funded a two-year research project that started in April 1994. The research involved 170 scientific fishing expeditions (trawl survey), the update of the catch records and the performance of morphological and biometric analyses on approximately 14,000 specimens of transparent goby.

As regards the fishing gear used, Article 9 of Regulation (EC) No. 1967/2006 lays down the rules on minimum mesh size of the nets. Paragraph 3 of Article 9 of the Regulation provides that for towed nets (boat seines) different from those pursuant to Paragraph 4, the minimum mesh size shall be 40 mm. Paragraph 7 of the same Article 9, to which the plan refers, provides that "A Member State may allow a derogation from the provisions set out in paragraphs 3, 4 and 5 for boat seines and shore seines which are based on a management plan as referred to in Article 19 and provided that the fisheries concerned are highly selective, have a negligible effect on the marine environment and are not concerned by provisions under Article 4 paragraph 5. In this regard, transparent goby fishing with a seine is not affected by the provisions of Article 4, Paragraph 5 because it is carried out in the nearby of and not directly in protected habitats (i.e., it cannot be performed on a sea bottom characterized by the presence of *Posidonia oceanica*).

1.2 National and Regional research concerning the transparent goby

Research activities concerning special fisheries have been promoted by MiPAAF since the seventies (e.g. Froglia, 1980). Supported by the Fishery Act 41/82, during the nineties they assumed a national relevance being carried out at the same time in different Italian seas and so enhancing comparisons of technical, biological and socio-economic results. In collaboration with MiPAAF the Italian Society of Marine Biology (SIBM) took care of the diffusion of the results by special issues of the Journal Biologia Marina Mediterranea:

- volume 5, fascicolo 3, 1998, Le ricerche sulla pesca e sull’acquacultura nell’ambito della legge 41/82 – Parte prima – Risorse biologiche e tecnologia, pag. 869

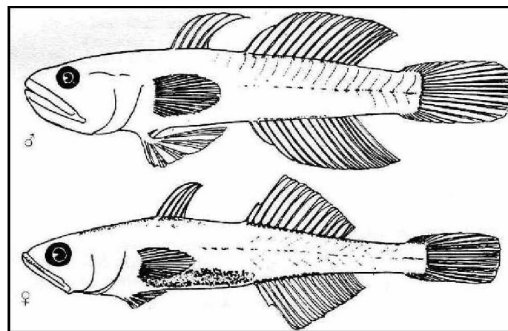
- volume 7, fascicolo 4, 2000, Le ricerche sulla pesca e sull’acquacultura nell’ambito della legge 41/82 - Parte quarta, - Relazioni, pag. 233

In particular, the present GSA 9 was represented by two Operative Units (Liguria and Tuscany) in a coordinated project concerning the biology and fishery of transparent goby Aphia minuta in the period 1995-1997, in collaboration with an Adriatic Operative unit (Auteri et al., 1998; Relini et al., 1998; Auteri et al., 2000). One of the specific aims of the project was to verify the impact, if any, of the boat seine and other gears on different fishery resources and on the bottom communities. The artisanal boat seines used in the Ligurian and North Tyrrhenian Sea resulted harmless for both, if fishery is carried out in the period November-March (Auteri et al., 2000).

Given the need to implement management plans for special fisheries with up to date data, the Regione Liguria have committed the Centre of Marine Biology of University of Genoa the monitoring of the fishery season 2009-10, also taking into account the socio-economic data monitored by fishermen associations.

CHAPTER 2 – BIOLOGY OF THE SPECIES

2.1 Classification

Phylum	**Chordata**
Class	**Actinopterygii**
Subclass	**Neopterygii**
Order	**Perciformes**
Family	**Gobiidae**
Genus	***Aphia***
Species	***Minuta***

Aphia minuta is commonly referred to in Italian as “rossetto”; in English it is called “transparent goby”, in French “nonnat”, and Spanish “chanquete” or “jonquillo”; other European names are: abu kerš, baghbagh, gianchëtu, gioviodàki aphia, makku, merrad, mliječ, Weissgrundel, etc.

The species has been widely studied in Europe since the 19th century and still arouses interest for various reasons: biological, genetic, environmental and as a resource for the fishing industry. Among the most recent literature, the contribution of scientific papers by Caputo et al., 2002; Brunet-Quetglas, 2004; Chesalin et al., 2004 ; La Mesa et al., 2008; Giovannotti et al., 2009; Ria et al., 2009, show the most relevant results.

2.2 Morphology

A thorough description of the species can be found in Relini et al., (1999): *Aphia minuta* is a small species no more than 6 cm long (Tortonese, 1975) with a short lifecycle and rapid maturation of the gonads. The specimens present a long body flattened laterally. The melanophores are very small. The scales are cycloid and easily lost. There are no scales on the nape of the neck or the first dorsal fin. The swimbladder is evident and persistent and the food canal is straight and short.
The adults are white, yellowish or pink; the body is transparent with a few black chromatophores. In proximity to the opercules a red spot can be observed due to the blood of the gills, visible because of the animal’s transparency. This species presents sexual dimorphism: the males have a larger head, uneven teeth, a higher caudal peduncle and the fins are more developed, especially the ventral ones.
Regarding distribution, this is a coastal species, pelagic in the larval and young stage. During sexual maturity the organisms acquire demersal-benthic habits.

2.3 Geographic and bathymetric distribution

As for the geographical distribution, *Aphia minuta* is spread throughout the Atlantic Ocean from Gibraltar to the Norwegian coasts, the North Sea and the western Baltic Sea. It is also present all over the Mediterranean basin including the Black Sea and the Azov Sea (Fig. 1 and 2).
Transparent goby is practically found in all the Italian seas down to a depth of approximately 80 m and it frequents mainly sandy and muddy sea floors (Fisher *et al*., 1987). Nonetheless, quite high concentrations of transparent goby, sufficient to sustain the development of targeted fishing, are found in clearly delimited areas (e.g. Baleares, Liguria, Tuscany, Sardinia, etc.).

Figure 1 – Distribution of *Aphia minuta* in the seas of Italy and Corsica (Relini et al., 1999)

Figure 2 – Distribution of *Aphia minuta* species by Fishbase (Froese and Pauly, 2009)

2.4 Lifecycle

The lifecycle is short, usually lasting only one year and ends shortly after reproduction.
The biological information seems to slightly differ from one area to another: for example in the Adriatic Sea reproduction lasts from May to August and the young specimens are caught during the winter season, though wide variations from one year to the next have been documented.
In the Adriatic Sea the minimum size of reproduction of females is 28 mm and in the literature the following fertility curve of Adriatic females is found (Froglia and Gramitto, 1989):

ln egg = 2.47196* Log total length– 0.54329 with r = 0.95

Information gathered from commercial catches shows that these are made up almost exclusively of females at the beginning of the fishing season (October-December), whereas the number of males increases from January onward: this is because at the beginning of the season the males are very small and therefore it is easier for them to escape the fishing gear (Serena *et al*., 1990).
The information for Tuscany, gathered by ARPAT on experimental fishing campaigns in the upper Tyrrhenian Sea, shows that the reproduction period lasts about six months, starting in March-April and ending in August-September (Baino *et al*. 2001). However, the analysis shows monthly fluctuations in the relatively large abundance seasons that could be due to stochastic variability but also to real fluctuations in the dynamic maturation patterns of the studied population.
According to Abella et al. (1997) specimens in the area are found between mid-September and mid-February with a medium specimen size of 2 cm.
Moreover, as already noted by Lo Bianco (1909) it is highly probable that the reproduction period, especially at its peak, fluctuates as the result of changes in environmental parameters.
Other hypotheses speak of subsequent moments of maximum reproduction variously spread throughout time, leading us to suppose that there are hatching “pulses” that would justify the subsequent presence of “micro-cohorts” as described by Baino *et al*. (1995).
The relationship between the size of the individuals and their fertility was determined in the upper Tyrrhenian Sea-Ligurian Sea (Auteri *et al*. 1996):

number of eggs = $0.333*TL^{2.380}$
In some years most births occurred in spring (March-May) and in other years they occurred in autumn (August-September) and as a result the population availability proves to be quite variable since the recruitment seems to be extended over several months .
The lifecycle of the transparent goby has phases with key different bathymetric and special distribution; after the larval phase, and having achieved a size of 15 mm, it goes through the semi-pelagic phase of life during which it tends to form large schools on which the seine is used to catch them. At the beginning of gonad maturation (35-40 mm) these fishes have more contact with the sea floor; then they reach the demersal phase. The birth occur predominantly in the spring, and commercial fishing starts in November, most of the individuals have already exceeded the size of 35 mm and are therefore more difficult to be catched by seine. The higher birth rate in the summer-autumn season makes it possible to take advantage of the aggregated phase of the population from November to March resulting in larger catches. As regards reproduction, the females ready to lay their eggs are found from February to August-September.
In the waters off Elba Island, for example, major recruitment occur in the winter months but there is also a second cohort in August; the post-larvae (TL <20 mm) have gregarious habits and form large schools that stay along the water column (Biagi et al., 1997).

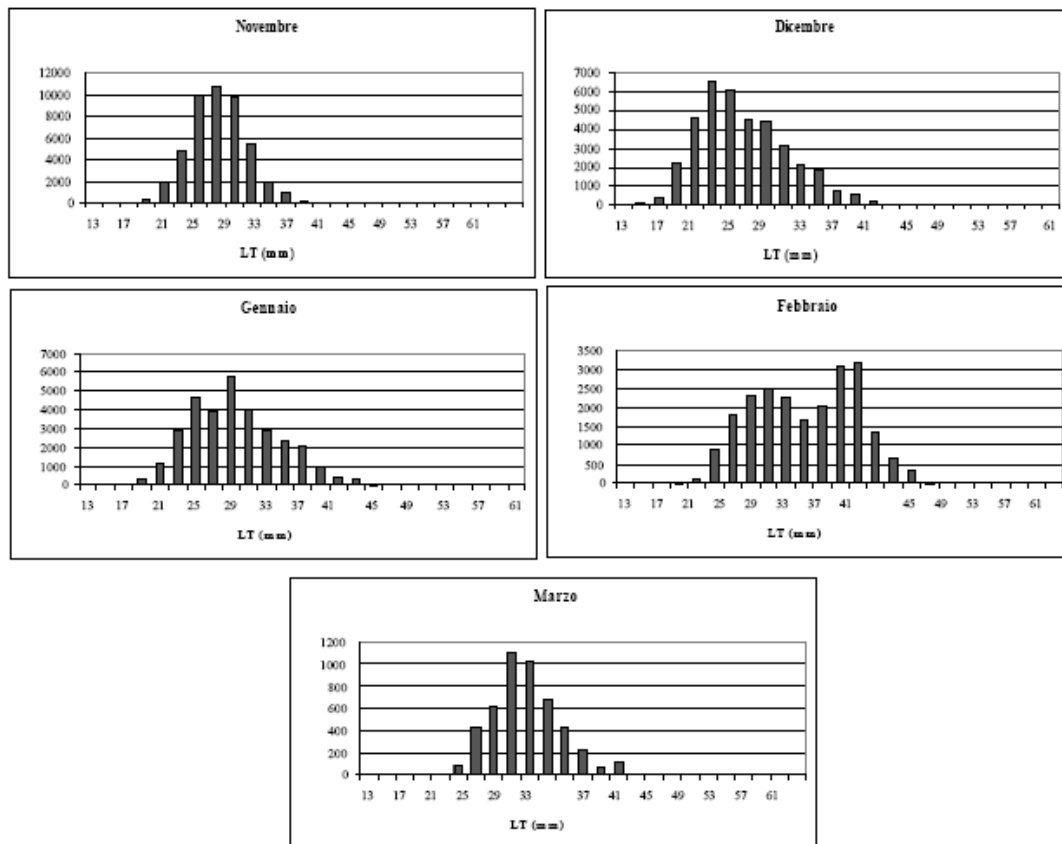



Figure 3 – Distribution of transparent goby by size/frequency (experimental campaign by ARPAT, 1995/1996)

Other investigations carried out in the Ligurian Sea show reproduction occurs in late winter and spring; the gonado-somatic index (GSI) values are very high around mid-March, when they reach as much as 29% of body weight. The minimum occurs during the summer months, increasing again in September. The smallest specimens (1-2 cm) start to appear in April (Relini et al., 1997) and have also been observed scuba diving at depths of 1-1.5 m (Tunesi et al., 1997). Beside the very clear spring recruitment in April-May other juveniles were observed mainly in July-August and November (Figure 4).

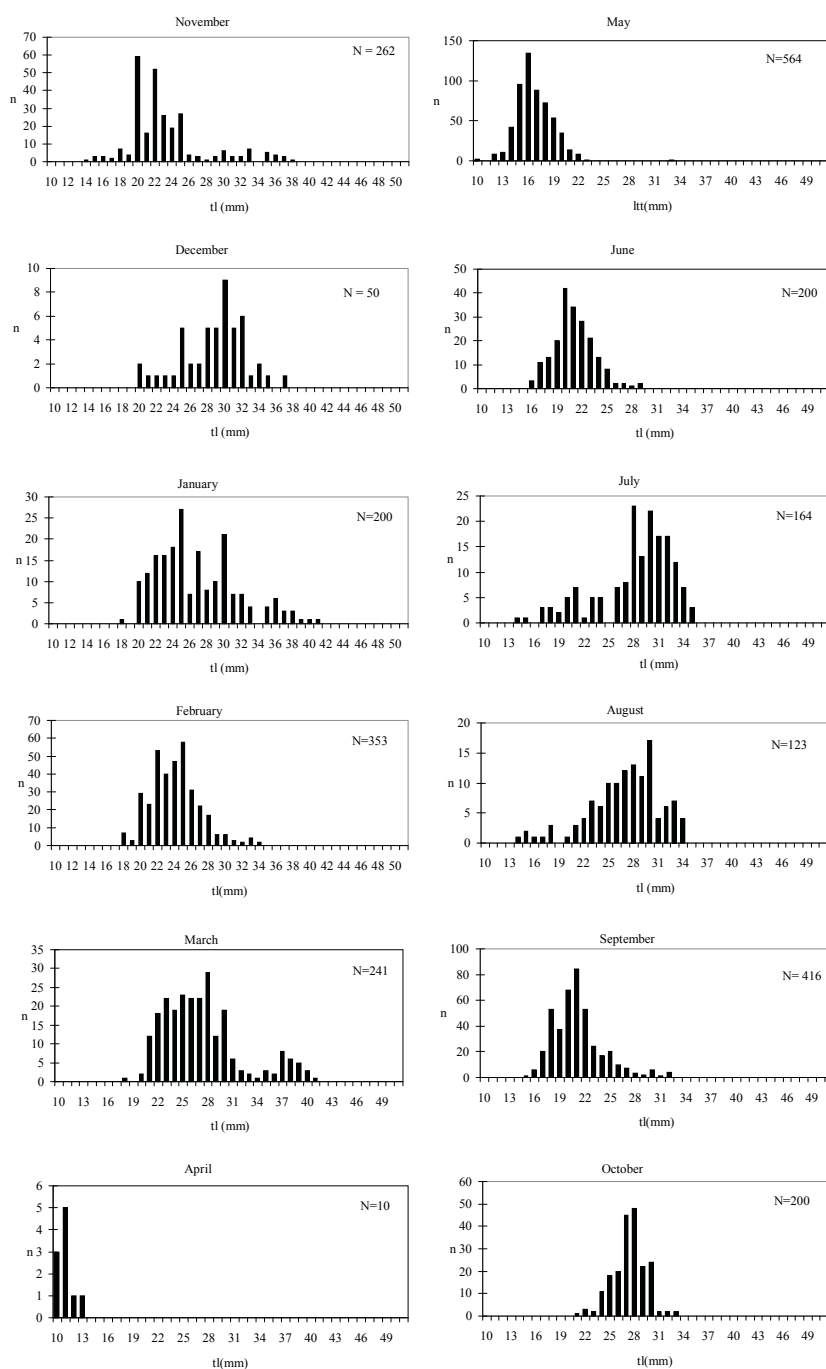



Figure 4 – Length/frequency distributions of transparent goby (Relini et al., 1998), MiPAAF research survey (Relini, 1997).

The illustrated time series are from a complete sampling carried out also outside the winter fishing season, according to the Research Program on special fishery funded by MiPAAF (Relini, 1997). These samples were collected directly onboard the fishing vessels of Camogli, from the area around Portofino

The correlation between length and weight was made by using over 10,000 individuals analyzed independently by sex and by different months of the year (Auteri *et al*., 1996). The curves created with parameters estimated in the various periods do not show significant differences. Therefore the following overall parameters were defined:

$$P = 1{,}48*10^{-6}*L^{3{,}401}$$

2.5 Growth

The growth model was obtained from 13 monthly surveys that made it possible to follow the modal classes (cohorts) throughout time with 14,000 specimens caught between April 1994 and April 1995.
The parameters defined in Baino *et al.* (1996) are K = 1.75 years^{-1} and Loo= 57.9 mm.

Time in years (0=1 January 1 - 31 December)

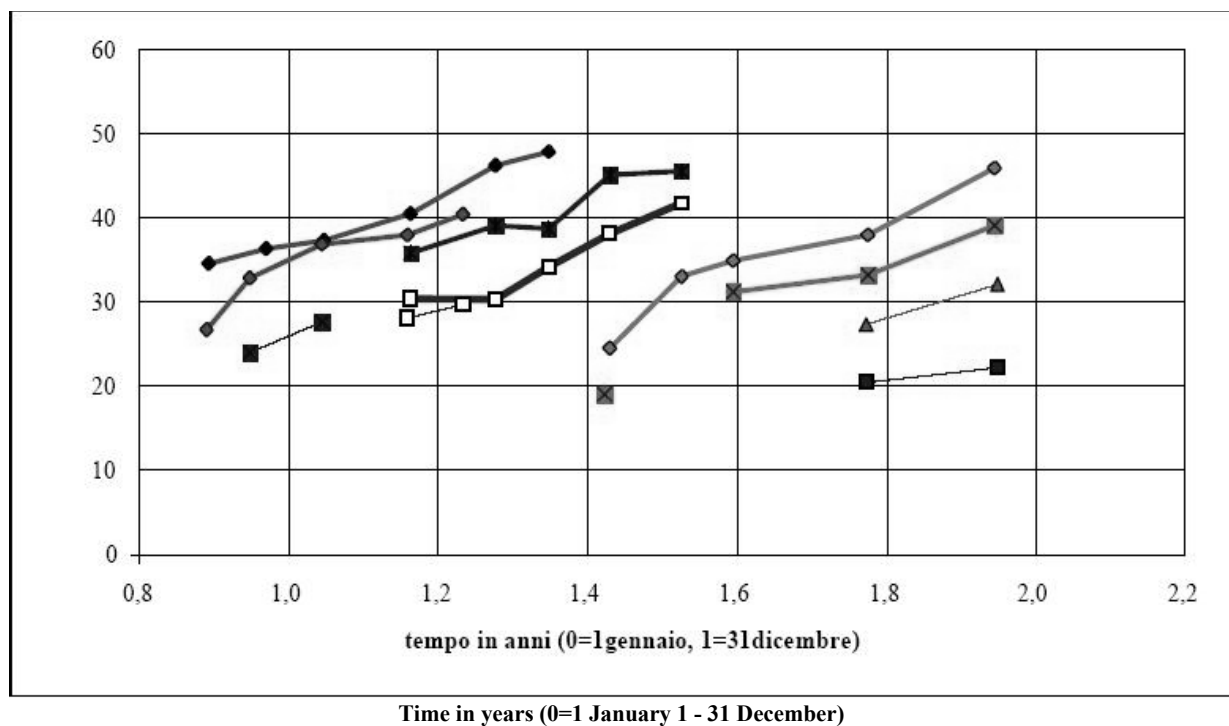



Figure 5 – Modal values of Gaussian cohorts identified in the survey

Having used size estimation by age with absolute age values, the t_0 values defined are different because they correspond to several subcohorts (see figure below). This confirms that the recruitment is different from one year to the next one, fractioned into pulses within the season. Lastly, this factor seems to be a greater cause of the fluctuations in commercial fishing catches.

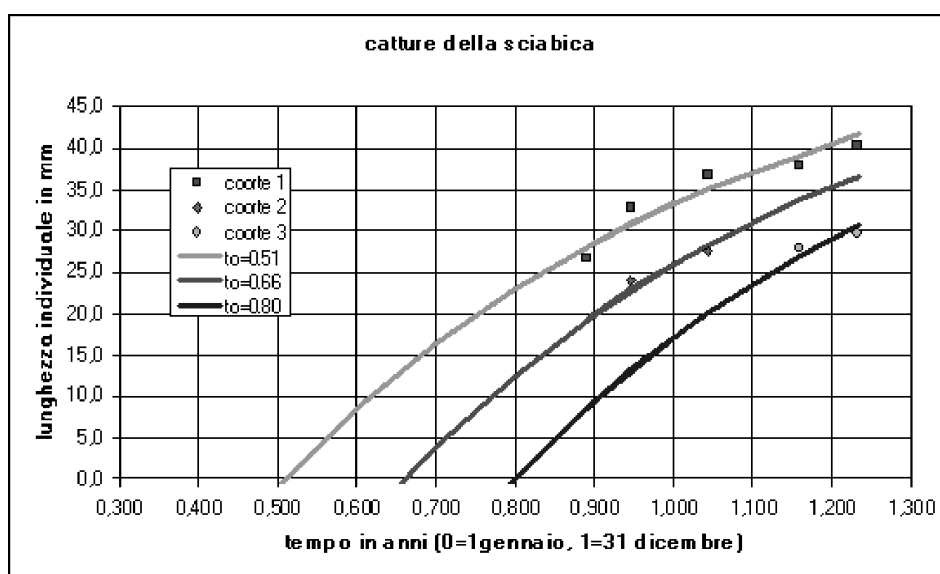



Figure 6 – Example of growth curve interpolated with three cohorts

Subsequently (Fig. 7) the growth model was also confirmed by reading the daily rings of the otoliths with a scanning microscope (Auteri *et al*., 1998).

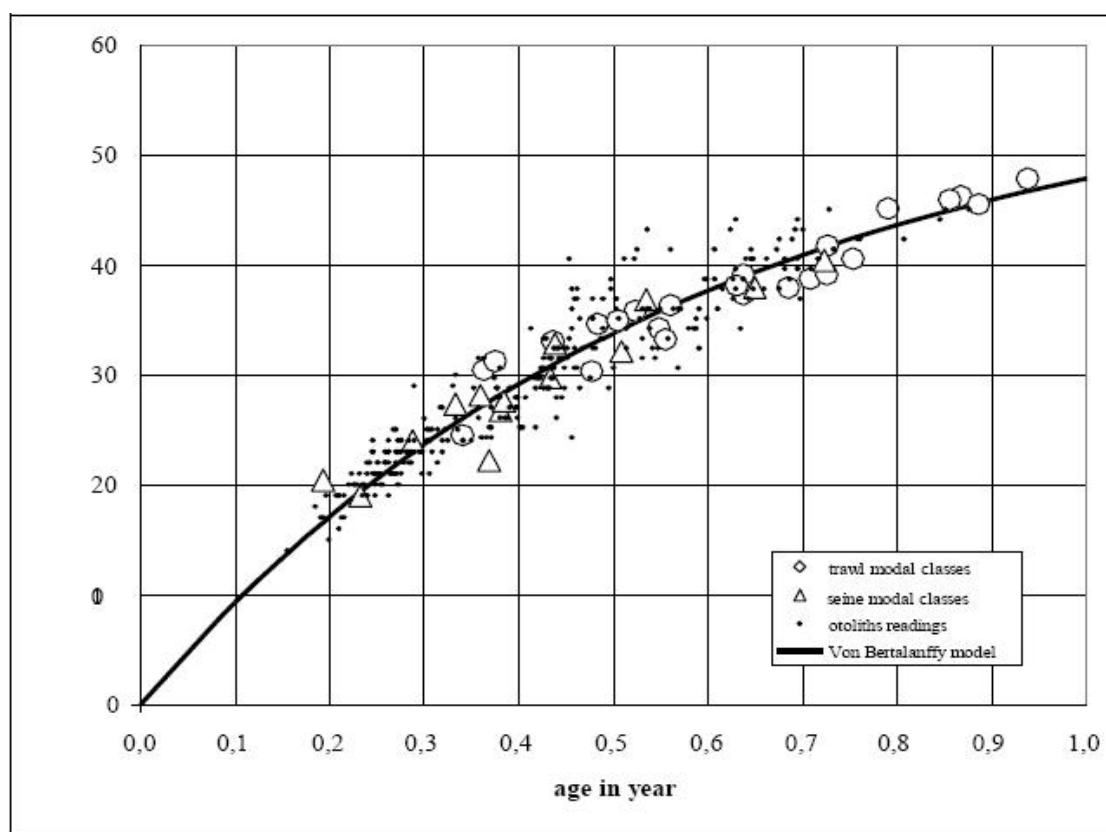



Figure 7 – Growth model of transparent goby (from Auteri et al., *1998)*

2.6 Maturity and reproduction

The surveys conducted by macroscopic examination of the gonads in the period 1994-1996 made it possible to evaluate the gonadic maturity index for both sexes in the various months of the year: only during bottom recruitment, starting in November, the portion of undetermined individuals was significant (Auteri et al. 1997). The percentage of mature females measured in the two subsequent years is given in the figure below.

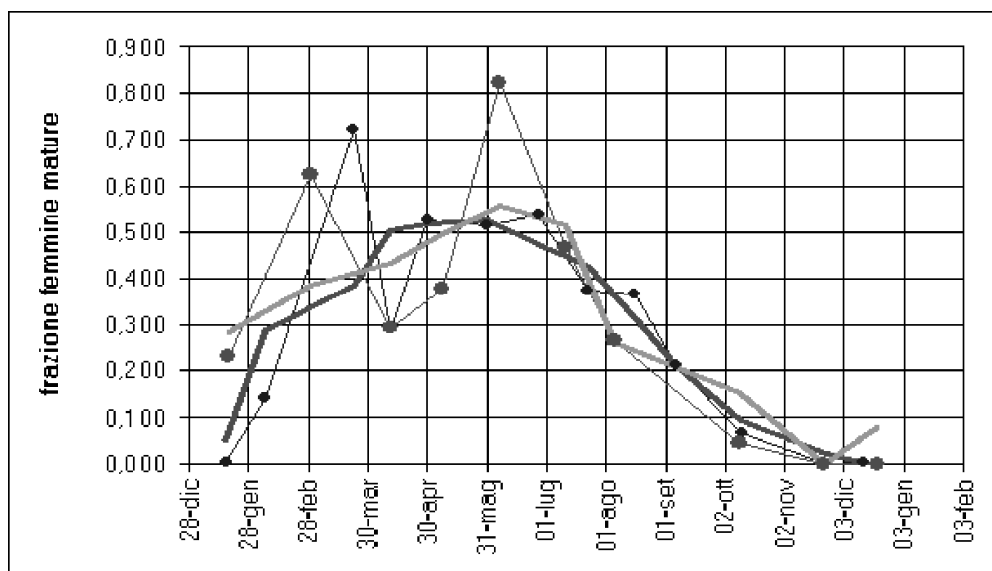



*Figure 8 – Gonadic maturation model of transparent goby (*from Auteri et al., *1998))*

The egg-laying period observed was rather extensive, starting in March 1994 and ending in around August. In September the presence of females poised to lay eggs is still significant (around 20%), though the population in the studied area has become rarefied. As already stated, it is highly probable that the reproduction period, and in particular its peak moment, fluctuates as a result of the variations in the environmental parameters.
The analysis of the results obtained from Martinez-Bano *et al*. (1990) confirm this hypothesis: the authors describe successive reproduction peaks spread throughout time, peaks that would lead us to suppose the presence of *pulses* which would in turn justify the successive presence of *microcohorts*, as described by Baino et *al*. (1995).
The early maturity size was calculated on a monthly base using the test data of 5,261 females and the equation taken from Pauly (1980):

$$FFM = 1/[1+\exp(S1-S2*LT)]$$

in which the fraction of mature females (FFM) is a function of the total length (TL) and the two parameters S1 and S2, defined the interpolation sigmoid.
These data have made possible to determine the parameters of various monthly functions for the period from February to August but, without statistically significant variations, the size of early maturity for the transparent goby was identified as having an average length of 43 mm.

2.7 Behaviour and ethology

Aphia minuta is a gregarious animal that tends to form numerous schools in proximity to the coast where it moves, presumably following the currents that transport masses of plankton, though it is possible to record its presence as deep as 50 m.
This species is often located in the nearby of river deltas and prefers sandy and muddy bottoms, including the meadows of marine phanerogamae.
It is an active predator for food as suggested by its morphology, dentition and behaviour. Above all, it is continuously searching for live prey. Adults feed mainly on holoplankton organisms, especially copepoda, cladocera, mysidacea, and meroplankton, in particular the larvae of crustaceans and bivalves, fish eggs and larvae.
Considering their small size and semi-pelagic life, both larvae and adults are particularly subject to predation that – along with the changes in environmental conditions – is their greatest cause of mortality.

2.8 Exploitation

Along the Italian coasts transparent goby is fished in shallow coastal waters from small boats, typically with a fine mesh seine (Relini *et al*., 1996), semi-pelagic trawl nets (Froglia and Gramitto, 1989), a seine or a drag net characterized by three overlapping sacks (Baino *et al*., 1996). The size of the first catch in GSA 9 waters has been calculated, for the 3 mm mesh commonly used for the seine, at between 10.5 and 13.2 mm (Serena *et al*., 1990) which is quite a bit lower than the minimum length recorded in the catches (25 mm). The study postulated that this can be explained by the fact that individuals between 10 and 25 mm long are not really caught by fishermen because they live in a more strictly pelagic environment.
According to the legislation in force, fishing is carried out from small boats between November and March in shallow coastal waters (as deep as 40 m).
On the Adriatic Sea the catches between 1979-1985 fluctuated from a minimum of 5 kg/boat/day to a maximum of 25 kg/boat/day (Froglia and Gramitto, 1989; Froglia *et al*., 1998).
As regards the GSA 9, upper Tyrrhenian Sea and the Ligurian Sea the data analyzed was taken from fishing records collected from November 1991 to April 2009 showing 19.9 kg/day/boat with a standard deviation of 3.4 kg/day/boat. The highest average values observed were 51.7 kg/day/boat in 2008 and the minimum values reached 12.3 kg/day/boat in 1994. The overall average yield for the entire period analyzed from 1991-2009 was 21.6 kg/day/boat.

CHAPTER 3 TRANSPARENT GOBY FISHING IN GSA 9

3.1 Structure of the seine

The seine is the specific gear used to fish transparent goby which in Tuscany is called “sciabichella” or “sciabichello”; in Liguria, the seine is called “rossettara”. The use of seine nets is among the most ancient ones. The name comes from Arabian and this gives the idea of the places where this gear where used in the past.
This net has unique constructive characteristics that dates back several decades and is not used for any other type of fishing but that of transparent goby.
Structure of the gear is essentially made up of two wings for a total length of between 100 m and 300 m but always shorter than 300 m, for larger boats. .
The structure of the seine consists of two wings made by four pieces that, starting from the net end, have decreasing sizes:

- The first piece has a 40 cm mesh;
- The second piece has a 20 cm mesh;
- The third has a 10 cm mesh;
- The fourth has the 5 cm mesh.

After this part, there is the body of the net is 6 m long including the sack. The lower portion of the body has a width of 1200 meshes of 7 mm each in a small net band with larger meshes.
The upper body has a width of 1000 meshes of 10 mm each and a net band with larger meshes. The local term for the bag is “tulle”; it is 1.5 m high and 4.5 m wide with meshes of 3 mm.
The drawings in Figure 8 and 9 show the constructive characteristics of the seine which, with minimal variations, is used for transparent goby fishing.

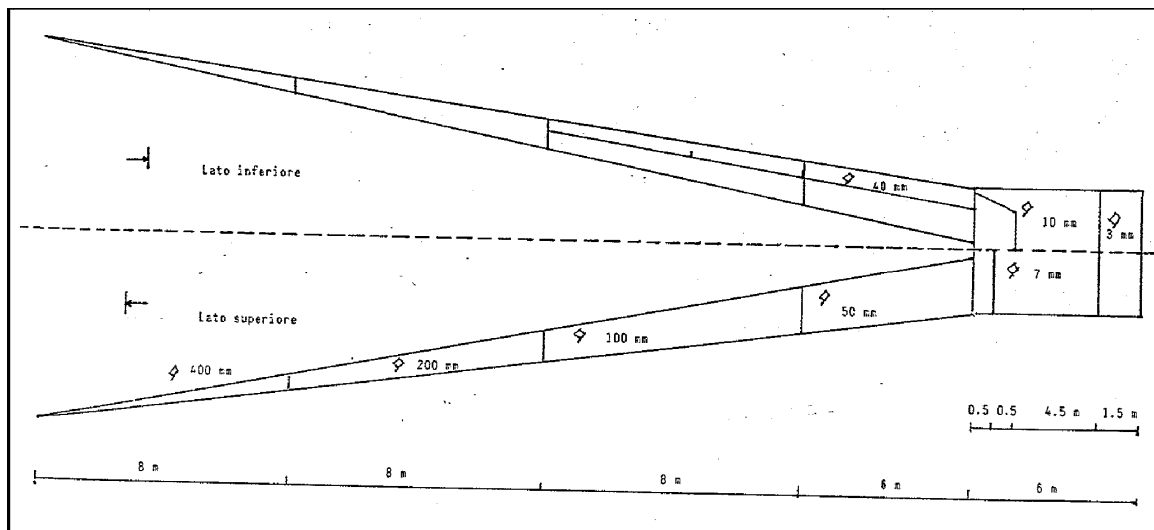



Figure 9 - Drawing of the transparent goby seine used in GSA 9

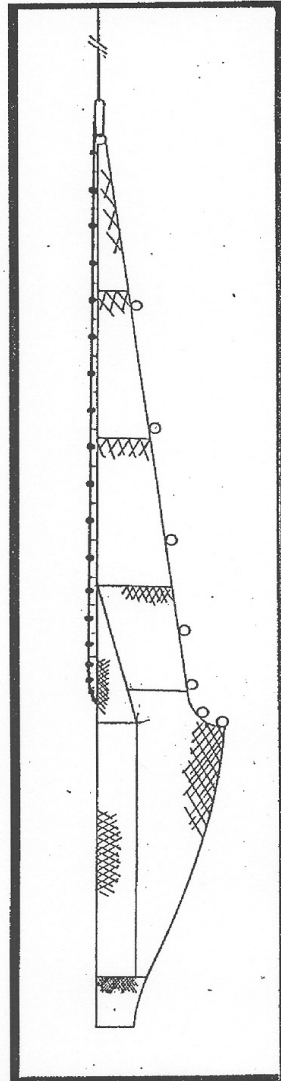



Figure 10 – Lateral view of the transparent goby seine and how it is used

The selectivity function of the Tuscan seine has been analyzed in detail by Auteri *et al*. (1989).
Two different approaches have been used to determine the size of the first catch (Lc); the first approach performs morphometric measurements of the fish (maximum conference, maximum height, standard length and total length) and uses specific ratios between these measurements as described by Pauly (1984). This method gives the size of the first catch Lc using the seine for transparent goby or fish with a similar structure, corresponding to 13 mm.

An alternative method is based on the analysis of the left side of the catch curve corresponding to classes not completely recruited. In this case 50% of the recruitment length is of 25.3 mm. This difference can be explained by the ethology of the transparent goby whose early life is pelagic and only after reaching a certain size (approximately 20 mm) it changes its habits and spatial distribution, gathering in schools near the seafloor where it is detected by the echo-sounder and where it is vulnerable to the gear. As a result, a theoretical potential LC of 13 mm and an LC of 25 mm among the population vulnerable to the seine is demonstrated.

3.2 Fishing technique

By conducting several surveys the fishing technique and the behaviour of the net on the seafloor has been identified. These observations were considered essential for the purposes of classifying the gear and assessing the impact of its use. The fishing expeditions consist of the following six phases:
Phase 1: the fish is identified on the seafloor at a depth of 5 - 30 m using an echo-sounder and its position in the water is marked by a small buoy (which in Italian is called “petagno”). To evaluate the actual nature and size of the school, the boat circles around it several times; this also allows it to quantify the force of the sea currents and their dominant direction.
Phase 2: the net is dropped with the prow of the boat facing against the current. On the external side of the school of fish the rope is dropped into the sea. It is approximately 50 m long at the top, with one end having a floater and the other connected to the wing of the net.
Phase 3: when the entire wing is underwater the boat is positioned along the side and windward with respect to the buoy. Then the mouth of the net is dropped into the current a few meters from the school. A poor assessment of this distance may result in a less than optimal positioning of the net with respect to the school and could cause the catching operation to fail.
Phase 4: once the body of the net is in the sea, the other wing is dropped, followed by the second rope which circles the floater until reaching it. The two ropes are then retrieved on board and left so the net can drop until it almost brushes against the seafloor.
Phase 5: the drawing up operation starts with the mechanical winch while the boat does not move. The ropes are slowly pulled back on board, then the wings, while the boat motor attempts to balance the applied force to the retrieval action.. Every 6 m on the tops of fishing lines there are signs that enable unbalanced recovery of the net. Another reference point is the buoy on the sea which must remain constantly in the centre of the net's mouth.
Phase 6: whereas the recovery of the ropes and wings is mechanical, that of the body and bag is manual. For this last operation the boat is positioned sideways, and the bag is hoisted aboard where its content is poured into a container.
The speed of the boat in the circling and net dropping phase is always slow (1-2 kn) and completely null during the catch of the fish school. This differs quite a bit from the speed of fishing when using the sea-bed and floating trawl fishing technique (of respectively 3-4 knots and 4-4.5 knots).
Fishing transparent goby does not require any mechanical or electronic device used during sea-bed fishing, with the exception of a small mechanical winch.
The conditions of the sea and weather strongly limit fishing which is carried out only during the day because at night the schools of transparent goby scatter, as do many gregarious species, and become difficult to find. Consequently the yields are lower and lose all economic interest.

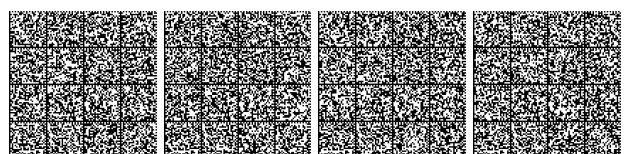



Figure 11 – Using the transparent goby seine in Tuscany

3.3 Fishing areas

Tuscany

In Tuscany fishing has been monitored measuring and recording catches in daily log books for over 15 years: the analysis of this data has allowed us to evaluate the structure of the fleet and determine the trajectories made between the base ports and the fishing areas. The information gathered from the 1991-1992 season to the 2008-2009 season also includes the season between November 1991 and April 2009.
31 fishing areas and 10 different base ports were identified. Then they were grouped into five different areas of activity: Livorno, Vada, Piombino, Follonica and Porto S. Stefano.
The port facilities at Livorno and Porto S. Stefano accommodate the larger boats having an average tonnage of 6.5 GT; Follonica has smaller boats with an average of 5 GT. The average fleet characteristics (+/- 1 standard deviation) are shown in Figure 12.

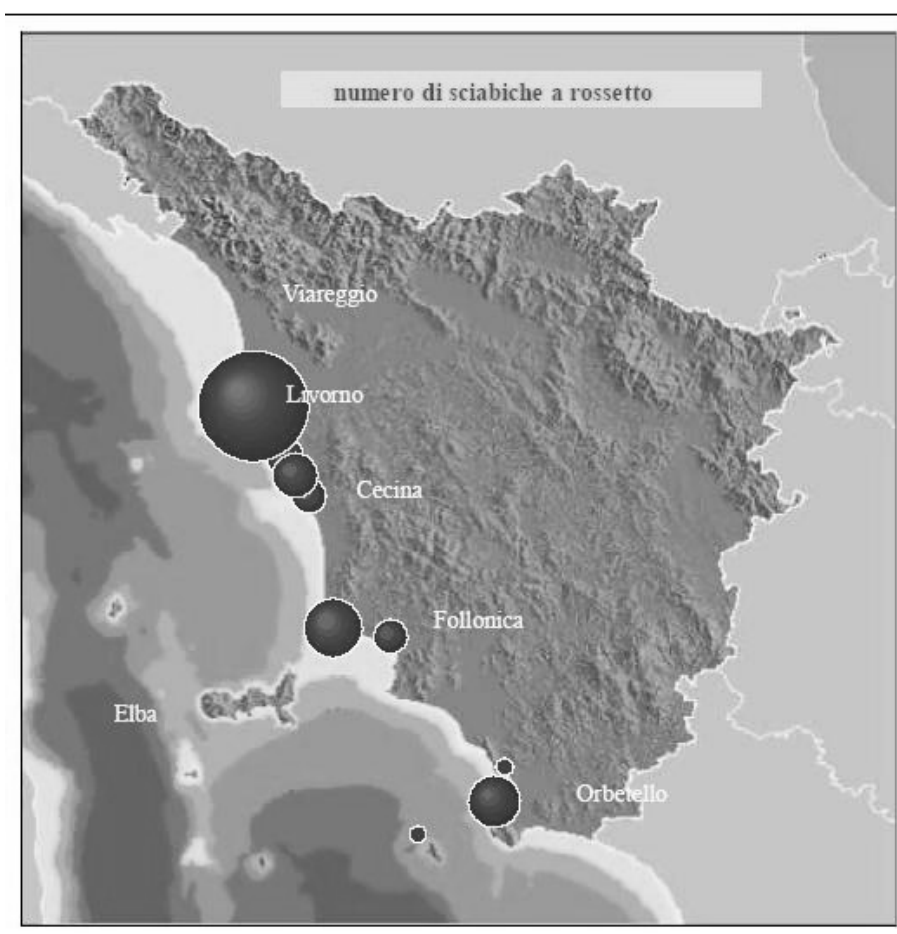



Figure 12 – Location of the 45 boats that fish transparent goby in Tuscany

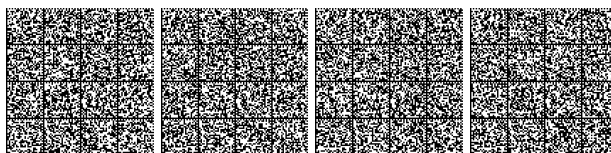
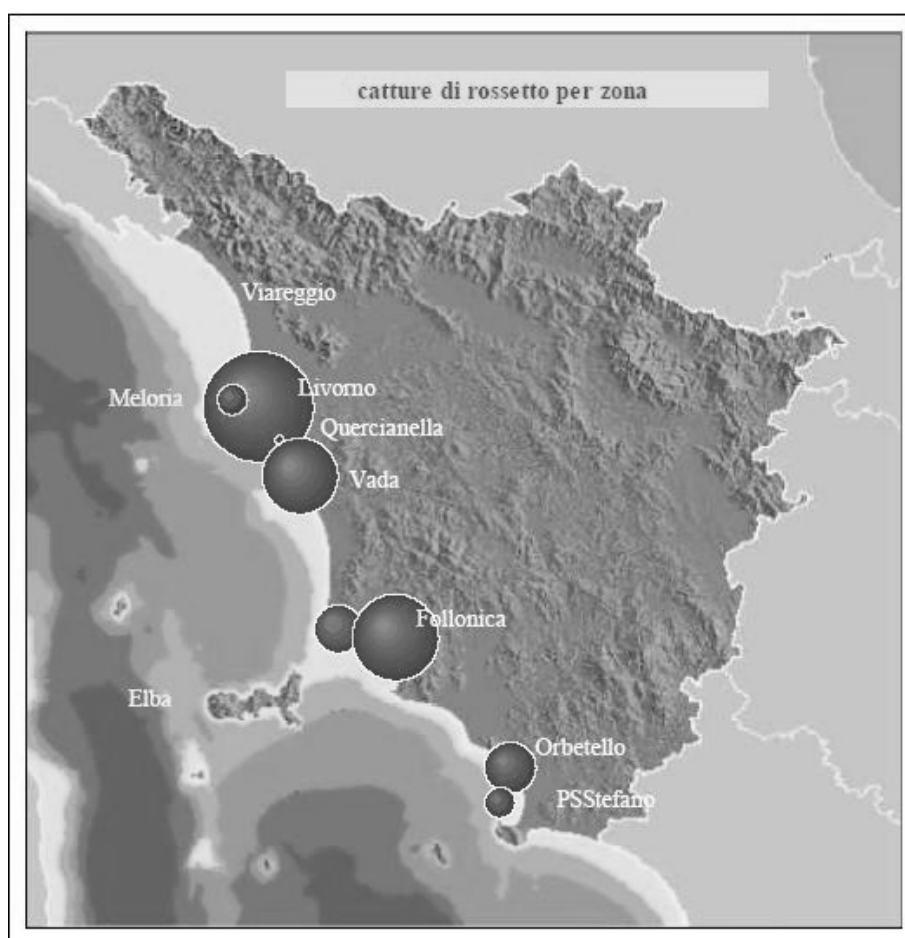



Figure 13 – Location of the area*s and abundance of transparent goby catches in Tuscany*

Table 1 – Area*s of transparent goby fishing in Tuscany and their degree of importance*

n	toponimi	zona	records
1	Antignano	Livorno	19
2	Ardenza	Livorno	17
3	Baratti	Piombino	343
4	Caianello	P.S.Stefano	3
5	Calambrone	P.S.Stefano	1452
6	Capo d'uomo	P.S.Stefano	13
7	Castiglioncello	P.S.Stefano	45
8	Cecina	P.S.Stefano	795
9	Foce Osa	P.S.Stefano	5
10	Follonica	Follonica	4892
11	Galletto	P.S.Stefano	1
12	Giannella	P.S.Stefano	15
13	Isola del Giglio	Follonica	112
14	Livorno	Livorno	3885
15	Luminella	Livorno	8
16	Meloria	Livorno	389
17	Molo Nuovo	Livorno	12
18	Monte Argentario	P.S.Stefano	557
19	Piombino	Piombino	1468
20	Punta Ala	Livorno	65
21	Puntone	Follonica	118
22	Quercianella	Vada	22
23	Riccitella	P.S.Stefano	1
24	Rosignano	Vada	10
25	San Vincenzo	Piombino	57
26	Shiplight	Piombino	107
27	Talamone	P.S.Stefano	1049
28	Tirrenia	Livorno	831
29	Torre Mozza	Follonica	2
30	Vada	Livorno	1895
31	Vestrini	Livorno	41
	Totale complessivo		**18229**

Table 2 – Overall fishing days using the transparent goby seine in Tuscany

zona di pesca	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**media**
Follonica	182	352	348	253	202	317	109	195	371	365	227	185	369	463	470	429	194	215	**291**
Livorno	524	470	504	413	432	444	392	376	248	321	403	387	322	479	267	182	436	164	**376**
Piombino	21	14	19	145	195	204	113	100	47	56	203	141	114	184	112	49	81	13	**101**
P.S.Stefano	108	91	70	70	130	122	120	98	108	145	95	155	77	128	23	54	18	32	**91**
Vada	119	193	115	28	209	305	108	166	203	184	180	176	156	163	192	59	87	121	**154**
totale giorni	**954**	**1120**	**1056**	**909**	**1168**	**1392**	**842**	**935**	**977**	**1071**	**1108**	**1044**	**1038**	**1417**	**1064**	**773**	**816**	**545**	**1013**
n° barche attive	**41**	**44**	**49**	**46**	**48**	**50**	**48**	**50**	**50**	**42**	**46**	**43**	**45**	**47**	**40**	**47**	**37**	**28**	**45**

Table 3 – Total catches of transparent goby in Tuscany

zona di pesca	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**media**
Follonica	3655	7733	3625	2034	2921	3321	1067	2720	7413	5070	4457	3222	5782	11008	10510	5859	5089	4508	**5000**
Livorno	14830	11639	8600	3867	8931	8058	5022	8021	4487	8129	8055	6819	5795	13043	5568	2549	17323	5645	**8132**
Piombino	510	132	529	1061	2385	1959	1309	1572	519	1031	3245	2103	1870	3556	1747	485	2640	332	**1499**
P.S.Stefano	3013	2931	812	1689	2602	2517	4306	4989	2068	1827	1818	2489	928	1993	894	1085	207	577	**2041**
Vada	3267	6230	1890	348	6643	5555	1221	2910	5810	4251	3261	3309	3176	5162	4284	943	3507	4855	**3701**
totale kg	**25275**	**28665**	**15456**	**8999**	**23483**	**21409**	**12925**	**20211**	**20297**	**20309**	**20835**	**17941**	**17550**	**34762**	**23002**	**10920**	**28767**	**15916**	**20373**

Table 4 – CPUE (kg/days/vessel) for trasparent goby seine in Tuscany

zona di pesca	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	media
Follonica	20,1	22,0	10,4	8,0	14,5	10,5	9,8	13,9	20,0	13,9	19,6	17,4	15,7	23,8	22,4	13,7	26,2	21,0	**16,8**
Livorno	28,3	24,8	17,1	9,4	20,7	18,1	12,8	21,3	18,1	25,3	20,0	17,6	18,0	27,2	20,9	14,0	39,7	34,4	**21,5**
Piombino	24,3	9,4	27,8	7,3	12,2	9,6	11,6	15,7	11,0	18,4	16,0	14,9	16,4	19,3	15,6	9,9	32,6	25,5	**16,5**
P.S.Stefano	27,9	32,2	11,6	24,1	20,0	20,6	35,9	50,9	19,1	12,6	19,1	16,1	12,0	15,6	38,8	20,1	11,5	18,0	**22,6**
Vada	27,4	32,3	16,4	12,4	31,8	18,2	11,3	17,5	28,6	23,1	18,1	18,8	20,4	31,7	22,3	16,0	40,3	40,1	**23,7**
kg/giorno	**26,5**	**25,6**	**14,6**	**9,9**	**20,1**	**15,4**	**15,4**	**21,6**	**20,8**	**19,0**	**18,8**	**17,2**	**16,9**	**24,5**	**21,6**	**14,1**	**35,3**	**29,2**	**20,4**

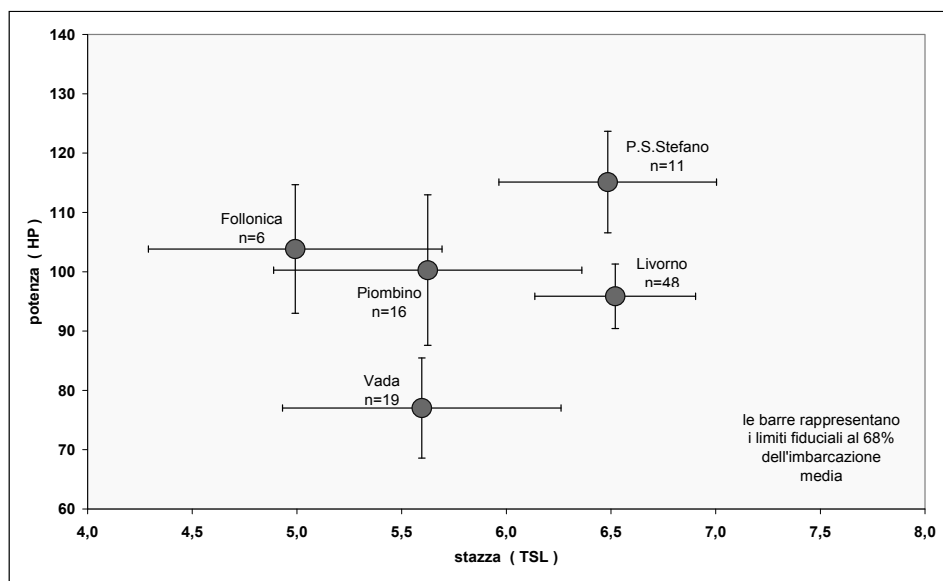



Figure 14 - Characteristics of fleet operating with transparent goby seine in Tuscany

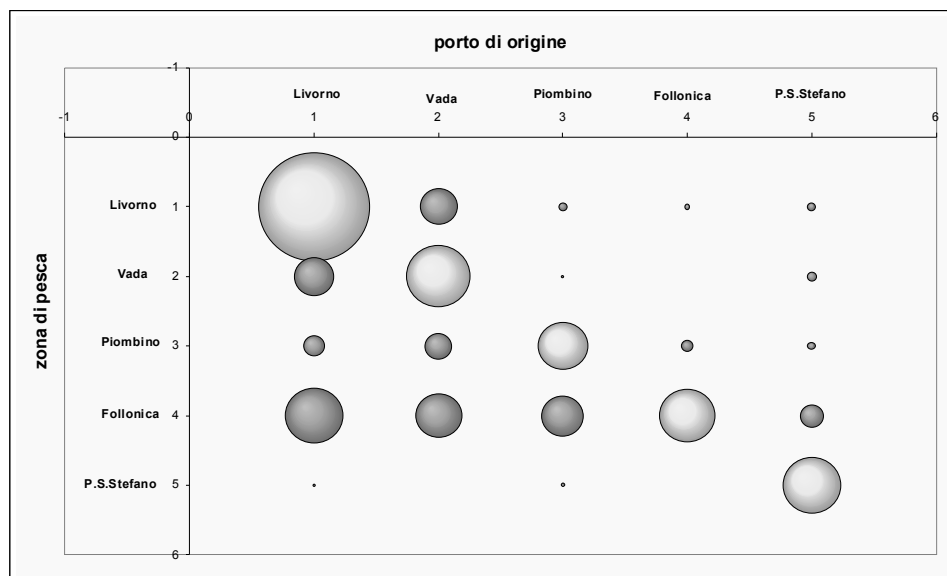



Figure 15 – Matrix of position of port of origin in relation to transparent goby fishing zones: the size of the bubbles is proportionate to the fishing effort.

The matrix shown in Figure 13 indicates that two-thirds of the fishing occurs in the area corresponding to base port of the fishing boats.

As regards the boat trajectories, Porto S. Stefano is the most isolated of all the areas. Moreover, in the area around the Argentario, local boats are practically the only fishing boats and are therefore more stationary. The boats at the port of Livorno are the ones that move the most. In all cases it is possible to observe a trend of southward travel. A total of 67% boats are stationary, varying from 62% to 73% in a single month. If we compare the variations in this percentage over the years, we see fluctuations from 55% in 1993 and 1999 to 80% in 1997 and 1998.

The assessment of boat movements among the five fishing areas reveals a positive move towards Follonica with 10% of those boats coming from Livorno, 5% from Vada and 3% from Porto S. Stefano and Piombino. If we exclude the reciprocal moves between the various areas, the result is 21% of moves travelling to the area of Follonica. The variations in each year of the study showed that in 1993 and 1999 there were more trips than they were made by 45% of the boats. In the other years we see a trend toward fewer trips, as occurred for example in 1997 and 1998 which registered 20%.

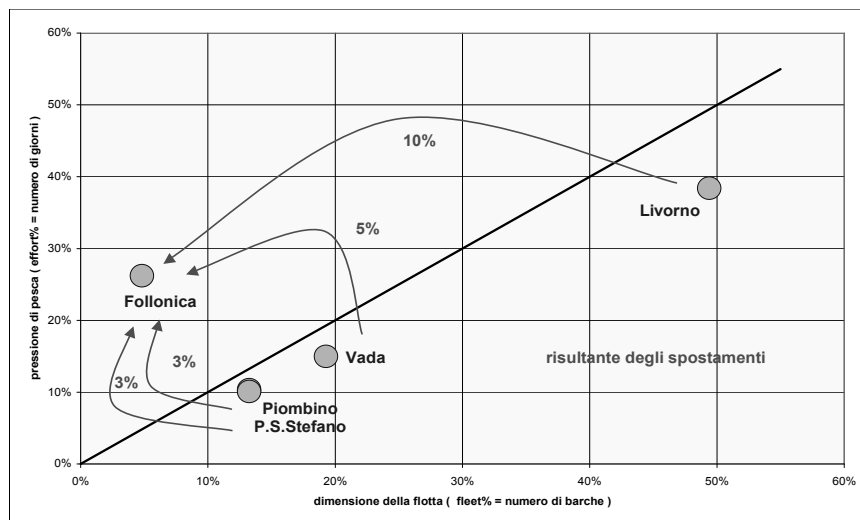
No correlation was observed between trip frequency and total catches, and nor was there any relation between the number of trips and the yields: therefore we can conclude that these trips of the fleet depended more on structural conveniences, e.g. mooring facility, than on actual concentration of the resource.

Fleet size (fleet% = number of boats)

Figure 16 – Result of fleet trips using the transparent goby seine

Liguria

Generally along the Ligurian coast the traditional fishing grounds are considerably decreased in the last few years for the overlap of different interests in the exploitation of the coastal area, such as the new building or enlargement of tourist marinas, laying of underwater pipe-lines, establishment of Marine Protected Areas. In particular, inside MPA these fishing activities have been managed by local Regulations, approved by Italian Ministry laws (Regulation of execution and organization of the MPA of "Portofino". M. L. 1 July 2008 gazed on U. G. 181 of 4/08/2008, article 21, 6 paragraph).

For the time being, traditional fishing activities are carried out on soft bottoms (sand and gravel); in fact, if the delicate seine nets were used on rocky bottoms or directly on coralligenous biocenosis, where carbonate organisms are abundant, the net could be damaged, causing great economic loss to the fishermen themselves.
In the same way, in order to avoid damage to the net or to the product, the transparent goby seine is not used on a sea bottom characterized by the presence of sea grass meadows, in particular *Posidonia oceanica.* The fishing activity could be carried out near but not directly on the Posidonia meadows, thereby respecting the provisions of Article 4, Paragraph 5

Fishing areas of the four Ligurian Marine Districts (table 5) are based on declarations to the Harbour-Office by local Fishery Associations representatives. Data were integrated with others available in the past literature, which can also include areas that are not nowadays exploited.

Table 5 – Fishing areas of transparent goby in the four Ligurian Districts. Fishing areas are graded from the most Westerly (Ventimiglia) to the most Easterly (Lerici)

MARINE DISTRICT OF IMPERIA	MARINE DISTRICT OF SAVONA	MARINE DISTRICT OF GENOA	MARINE DISTRICT OF LA SPEZIA
VENTIMIGLIA	ANDORA	ARENZANO	DEIVA
BORDIGHERA	LAIGUEGLIA	VESIMA	FRAMURA
OSPEDALETTI	ALASSIO	GENOA	CINQUE TERRE
SANREMO	ALBENGA	NERVI	LA SPEZIA
ARMA DI TAGGIA	LOANO	BOGLIASCO	LERICI
IMPERIA ONEGLIA	FINALE LIGURE	SORI	
	VARIGOTTI	RECCO	
	NOLI	CAMOGLI	
	VADO LIGURE	PORTOFINO	
	SAVONA	RAPALLO	
	ALBISOLA	ZOAGLI	
	CELLE LIGURE	CHIAVARI	
	VARAZZE	CAVI LAVAGNA	
		LAVAGNA	
		SESTRI LEVANTE	
		RIVA TRIGOSO	
		MONEGLIA	

3.4 Fleet composition

Tuscany

The Tuscan transparent goby fishing fleet is located in 11 marines.

Table 6 – Boat codes, their number and harbour locations in 2009/2010 of the Tuscany fleet fishing the transparent goby.

marineria	cod. matricola	cod. porto	n. barche
Livorno	**LI**	LI	20
Piombino	**1 LI**	PB	5
Porto Santo Stefano	**2 LI**	PSS	6
Follonica	**3 LI**	FO	4
Vada	**5 LI**	VA	6
Marina di Cecina	**6 LI**	VA	1
Castiglioncello	**11 LI**	VA	3
Castiglione della Pescaia	**12 LI**	PB	2
Talamone	**14 LI**	PSS	1
Total Tuscany			**48**

The number of active boats varies throughout the years from 37 to 50 units with an annual average of 45 active boats. The table below shows the number of fishing days that each boat dedicates to fishing transparent goby in decreasing order. The next table shows the identification and structural characteristics of the fleet. It is worthwhile to stress that each year only around 50 boats are allowed to fish the transparent goby. The overall number is due to the fact that many owners of the authorization have changed the boat, or the license have moved e.g. from father to son or inside the shipowner cooperative. It is worth noting that, while the potential

fishing effort can rise to around 60 days/year per boats, 50% of the boat fish less than 20 days/year, being this activity usually an alternative to other gears, usually trammel nets.

Table 7 - Historical list of the 100 boats that fished the transparent goby in Tuscany along the period from 1991 to 2009

n	cod. barca	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	media
1	11LI 191			52	52	34	43													**45**
2	LI 10011						44	29	40	37	40	46	51	30	75	72	41	38		**45**
3	3LI 609													64	39	47	50	30	27	**43**
4	LI 9816	52	36	55	46	61	48	21	29		40	40	46	20	52	22				**41**
5	LI 9902	51	43	61	37	58	52		12	17	46	37	39	21	47	49	28	66	9	**40**
6	11LI 1239						39	26	37	21	41	14	59	34	73	58	42	37	27	**39**
7	LI 9881	35	82	45	39	19	42	22	39	52	40	39	43	58	16	19	10			**38**
8	11LI 1249														58	58	28	4		**37**
9	LI 9591	47	40	45	11	32														**35**
10	11LI 1227						30	17	31	28	38	31	33	26	54	44	43	24		**33**
11	LI 9636										38	33	38	24						**33**
12	LI 9951	24	6	24	50	53	47	24	29	27		32	27	30	59					**33**
13	1LI 1318																32			**32**
14	LI 7000	44	39	41	14	25	25	28	31	35										**31**
15	1LI 1324	23	33	39	48	47	58	34	29	9	8	42	23	4	34	36				**31**
16	1LI 1373									25	24	36	31	26	43					**31**
17	3LI 598			24	33	27	19	21	30	33	26	25	29	36	55	29				**30**
18	1LI 1376														45	29	23	22		**30**
19	3LI 594				3		35	14	32	20	21	30	33	25	65	36	42	22		**29**
20	5LI 763		39	47	51	42	45	20	26	18	17	25	32	18	38	21	9	17		**29**
21	2LI 2746	36	31	28	22	54	51	27	21	26	28	19	39	18	24		11			**29**
22	6LI 434									6	42	39								**29**
23	LI 10035									33	31	26	12	37	30	31	29			**29**
24	LI 7898	30	34	27	18	20	34	37												**29**
25	3LI 611																32	25		**29**
26	LI 9888	46	49	32	38	57	52	4	6	17	24	21	8	32	25	31	23	15		**28**
27	LI 4951	8	15	8				19			33	41	45	27	35	56	39	30	8	**28**
28	LI 9593	19	37																	**28**
29	6LI 402	49	43	27	39	22	29	13	18	23	23	18								**28**
30	3LI 597		19	2	1	24	44	18	42	21		28		20	54	41	29	37	21	**27**
31	9LI 371			28	2	23	28		3	35	27	26	14	47	55	43	14			**27**
32	5LI 766	44	33	13	7	11	31	28	20	38	35									**26**
33	LI 594		13	42	39	10														**26**
34	1LI 1337		20	26	22	33														**25**
35	LI 10054																18	32		**25**
36	LI 9996						46	19	22	13										**25**
37	LI 9839	19	35	28	14	21	44	27	25	9										**25**
38	5LI 787											38	33	35	16	20	7	32	14	**24**
39	11LI 1228	28	20																	**24**
40	1LI 1341		14	22	44	28	30	9	21											**24**
41	6LI 430				36	33	29	18	11	11	24	29	16	25						**23**
42	6LI 422	27	34	13	13	32	26	23	33	4										**23**
43	12LI 156															31	15	21		**22**
44	LI 9617					8	16	7		42	30	45	42			6	5			**22**
45	LI 9856	14	29	26	18	25	18	26	22											**22**
46	LI 9950	39	35	31	8	14				40	41	35	2	19	20	15	7	21	6	**22**
47	LI 9891								22											**22**
48	5LI 315				6	10	32	13	24	20	24	33	44	50	15	19	7	26	6	**22**
49	1LI 1285	26	34	18	28	21	22	6	17											**22**
50	LI 10121																	18	25	**22**

51	5LI 779			10			23	26	25	17	25	30	31	21	14	13				**21**
52	LI 9766	2	4	12					10	32	37	13	32	30	41	23	38	17	6	**21**
53	LI 10024																	24	18	**21**
54	LI 9957	1	21	25	19	19	33	25	26	20										**21**
55	1LI 1335			11	31	26	24	8												**20**
56	LI 8610	23	24	17	10	23	29	9												**19**
57	LI 10074												26	15	27	22	8	16		**19**
58	1LI 1321	28	27	20	8	16	11	9	14	24	22	27	14	34	29	10	9	17	7	**18**
59	2LI 2637	6	16	7	13	14	6	29	15	25	25	26	32	16	27		13			**18**
60	LI 9770	27	20	7	8	8	18	26	9	13	26	30	21	38	12	14	5	25	13	**18**
61	LI 10032									2	27	23								**17**
62	LI 9829	41	28	19	9	16	9	11	3											**17**
63	1LI 1375								3	26	23	17	15	17						**17**
64	5LI 752	19	28	12	5	15	25	15	30	7	6	13	9	29	18	13	12	29	11	**16**
65	altro		17	4	4	37	14													**15**
66	5LI 792																		15	**15**
67	2LI 2801	9	16	15	11	24	25	8	6	10	20	17	29	12	22		13		1	**15**
68	LI 9986																17	12		**15**
69	LI 7981	30	30	13	4	10	10	15	3											**14**
70	LI 9920	3				12	17	8	12	37					10					**14**
71	LI 10021															22	6			**14**
72	2LI 2810	10	12	4	6	12	7	20	16	15	23	18	36	11	22		6	11	5	**14**
73	LI 9616								8	4	6	6	4	8	11	45	12	29		**13**
74	LI 9987			27		19	15	17		29	14	9	3	1	26	6	1	14	2	**13**
75	3LI 606																7	25	7	**13**
76	1LI 1279		12	18	25	27	31	13	19	11		1		2	2	3	4			**13**
77	LI 9665	26	12			12		9	3											**12**
78	2LI 2794	8	5	4	8	18	18	25	16	11	23	4	9	11	15	23	8	7	5	**12**
79	LI 10127																	15	9	**12**
80	2LI 2795	15		7																**11**
81	LI 9620	6				4					1	22	17	8	17					**11**
82	2LI 2607	10	10	3	6	8	13	8	9	10	19									**10**
83	LI 10065											3	4	13	13	13				**9**
84	LI 10098														12	13	4	13	4	**9**
85	LI 9834	14	14	9	1		1	3	5	5	17	5	6	9	13	11	9	20	6	**9**
86	LI 10013								14	2										**8**
87	LI 10040									5	9	5	2	11	16					**8**
88	5LI 727												5	4	15	11	4			**8**
89	LI 10083													13	10	1	1	12		**7**
90	14LI 36									7		7	4	9	15		2			**7**
91	1LI 1395																	10	2	**6**
92	5LI 793																		6	**6**
93	LI 1044															8	5	3	4	**5**
94	1LI 1356						2	5	7											**5**
95	LI 9644	1	10	5	1															**4**
96	2LI 2797	10		2	1	4	2	3	8	4	7	4	6		3		1			**4**
97	11LI 1251																		4	**4**
98	12LI 190																4			**4**
99	LI 10034								2	1									7	**3**
100	2LI 2739	4	1	1																**2**
	totale giorni	**954**	**1120**	**1056**	**909**	**1168**	**1392**	**842**	**935**	**977**	**1071**	**1108**	**1044**	**1038**	**1417**	**1064**	**773**	**816**	**275**	**998**

As regards the structural characteristics, the transparent goby fishing fleet has a tonnage from 1 to 15 GT, a motor power ranging from 12 and 118 KW. The average boat has 6.1 GT, 72 KW and an overall length of 10 m.
While the frequency distribution of boat length is fundamentally Gaussian, tonnage values are between 2 and 8 GT with a peak at 4. Twenty percent of the boats is grouped in the 9-10 GT segment; the reason for this is mainly to comply with legislative provisions because boats larger than 10 GT cannot practice this type of fishing (Ministerial decree 28/8/96).

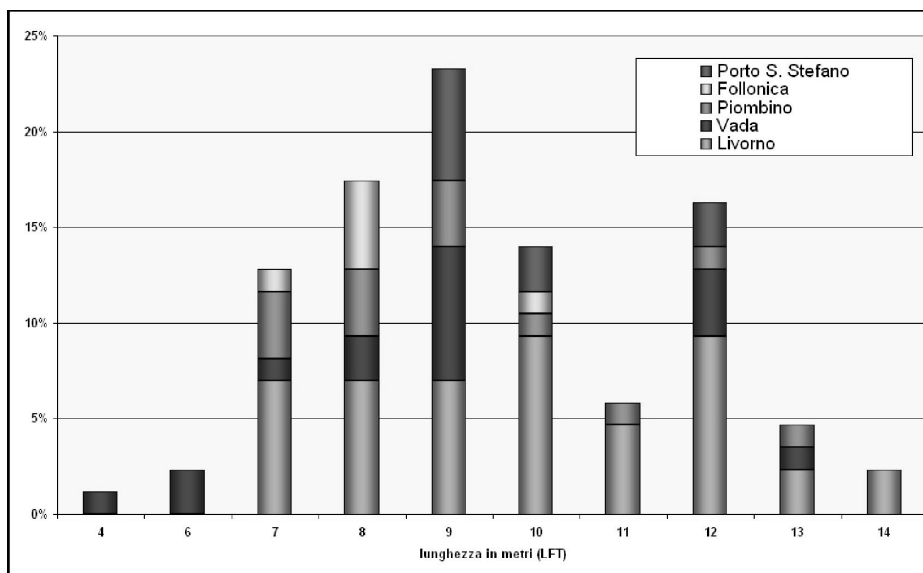



Figure 17 - Dimensional structure (length) of fleet using the transparent goby seine

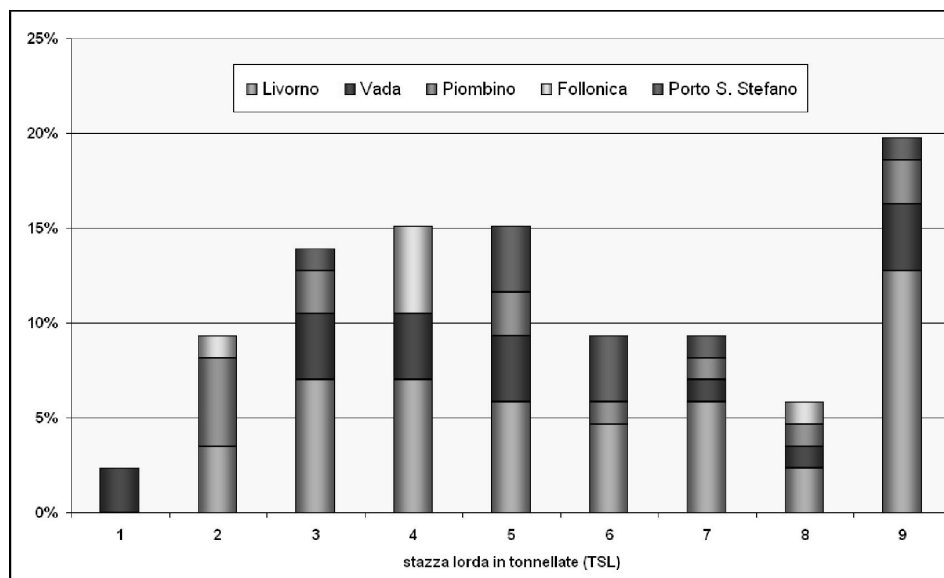



Figure 18 – Dimensional structure (tonnage) of fleet using the transparent goby seine

Seasonal fishing is done mainly between November and February when an average of 94% of the days are dedicated to fishing transparent goby. Anywhere between 8 and 12 boats go out per day between November and February (Figure 18). In the period from March to April the average drops to two boats a day so during that time the activity can be considered marginal. As regards the number of boat trips throughout the various fishing areas, these occur mostly between November and January.
A comparison of the number of trips in November and February shows that fishing intensity is generally the same in both months. However in November boats tend to move the most with values about 25% while in February the trips are slightly lower (at 20%).

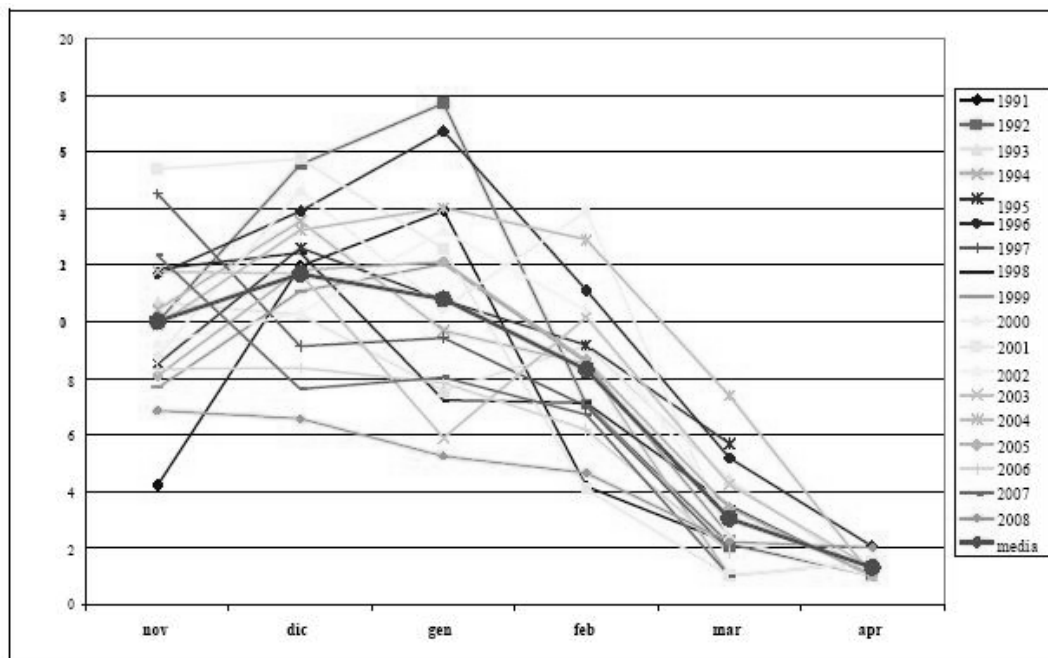



Figure 19 – Monthly fishing intensity of fleet using the transparent goby trawl

Considering the fishing days, on 16% of transparent goby fishing days only one boat goes out; on 9% of the days two boats go out, etc. as shown in Figure 18.
However it is very rare to see more than half of the fleet go out on fishing days (3%): the average number of active boats for each fishing day is 9.03.
This number leads to the conclusion that, though the potential capacity of the fleet in Tuscany is of 50 boats, considering the behaviour of the commercial fleet in the past 20 years, the capacity actually used is only $^{1}/_{5}$.

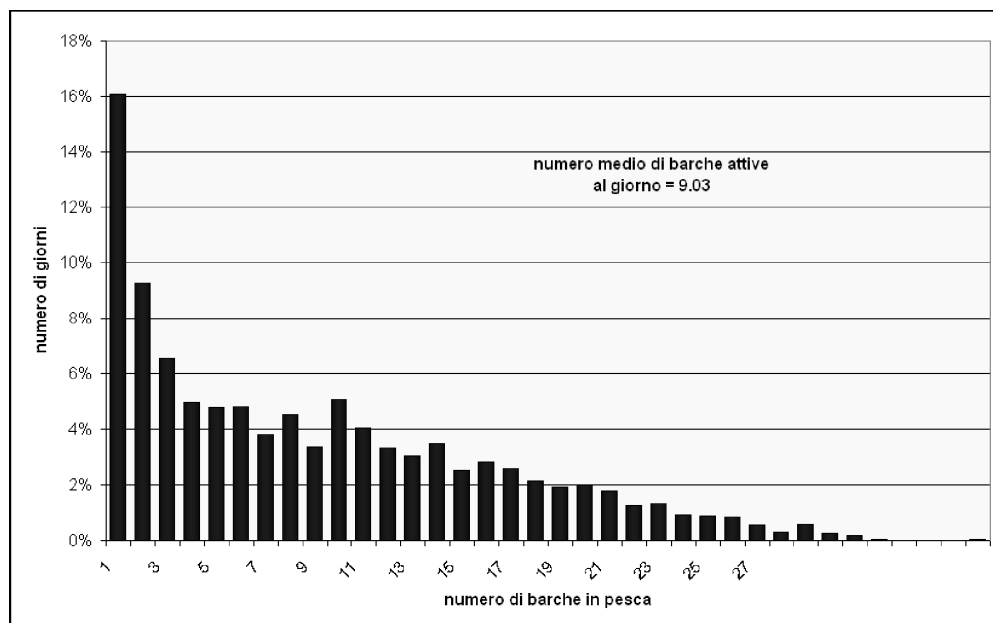



Figure 20 – Distribution of fishing intensity

It has been verified that the number of boats that go out to fish transparent goby is not correlated to the yield of fishing on that day. Hence the determining factor of whether or not a boat decides to go out is not an economic one but mainly based on weather and sea conditions: this particular kind of fishing with the seine requires very calm sea conditions in order to operate efficaciously.

Table 9 - List of the 48 boats that fished the transparent goby in Tuscany in 2009/2010. Along with boat codes and characteristics, the fishing days (targeting the transparent goby) are reported for each fishing season in the last five years

	ITA code	UE num	Name	GT	KW
1	06 LI 00402	5418	ALBATRO	2	97
2	00 LI 09616	5070	ANDREA	2	33
3	00 LI 09987	9415	ANNA	9	106,6
4	00 LI 10054	24966	AQUARIUM	6	68,4
5	00 LI 10119	5212	AZZURRA	7	94
6	00 LI 10127	27001	BELLA FRANCA	2	68,4
7	00 LI 10034	3839	BRASILIA	12	88,5
8	03 LI 00597	17924	CORSINIA	4	84
9	03 LI 00606	5613	DANIELA	4	81
10	00 LI 09617	5071	DELFINO	4	59
11	02 LI 02746	5268	ELEONORA	4	107
12	03 LI 00594	5344	ELIA	3	61
13	00 LI 10110	17142	FILOMENA	2	30,8
14	05 LI 00787	5235	FIORINA	2	53
15	00 LI 10074	5411	FRAGI	3	62,5
16	12 LI 00113	17925	FRECCIA DEL NORD	2	65
17	01 LI 01321	5210	GABBIANO II	8	110,5
18	00 LI 09834	5126	I SEI FRATELLI	11	110,5
19	00 LI 04951	5038	ICEBERG	8	61,78
20	05 LI 00315	5357	JONA	9	36,7
21	11 LI 01227	5525	KATIA	3	97
223	01 LI 01279	5197	LAURA SECONDA	3	26
23	00LI 10140	27779	LUCIANA II	4	81
24	00 LI 10121	27206	LULU'	5	80,06
25	01 LI 01395	2776	MADONNA DI FATIMA	4	85
26	01 LI 01376	18707	MAESTRALE	3	97
27	02 LI 02794	5297	MAGA	3	92
28	02 LI 02797	5299	MANOLO II	5	92
20	02 LI 02810	5308	MOCRI IIª	3	97
30	11 LI 01251	27345	NIKE	3	41
31	11 LI 01239	18882	NIROSI II^	15	110
32	00 LI 10124	27297	OLIMPIA	8	95,6
33	00 LI 09986	17253	PICCOLA ILARIA	10	117
34	05 LI 00752	5389	PIGRA	5	68,4
35	01 LI 01318	5208	PIOSHI II	2	14,5
36	12 LI 00156	5558	RAMBO	4	109,59
47	05 LI 00792	27386	ROSY	3	41
48	05 LI 00763	5394	RUELA	2	42
39	02 LI 02801	5301	S. GIORGIO II	2	63
40	00 LI 09766	5099	SAN GENNARO II	10	73,5
41	00 LI 10011	19570	SAN PROCOLO	12	66
42	00 LI 10098	26475	SANT'ANNA I^	7	59

	ITA code	UE num	Name	GT	KW
43	02 LI 02637	5242	SANTO STEFANO	2	63
44	14 LI 00036	8224	SIRENA	9	95,5
45	00 LI 09950	5188	SQUALO	3	66,2
462	03 LI 00609	25706	VANESSA	3	41
47	05 LI 00793	27528	VITTORIA	1	44,12
48	00 LI 09770	5103	ZORRO	8	58,8

Liguria

At present the Ligurian fleet for transparent goby consists of 94 vessels which obtained the specific licence in 2009-2010. The quantity of fishing-licences seems to be stationary in the last 17 years, albeit with some fluctuation. The distribution in the four Liguria Marine Districts as well as the main characteristics are given in figures 21-22-23 and in table 9. The Marine District of Genoa is the most representative with about 60% of the licences in Liguria.

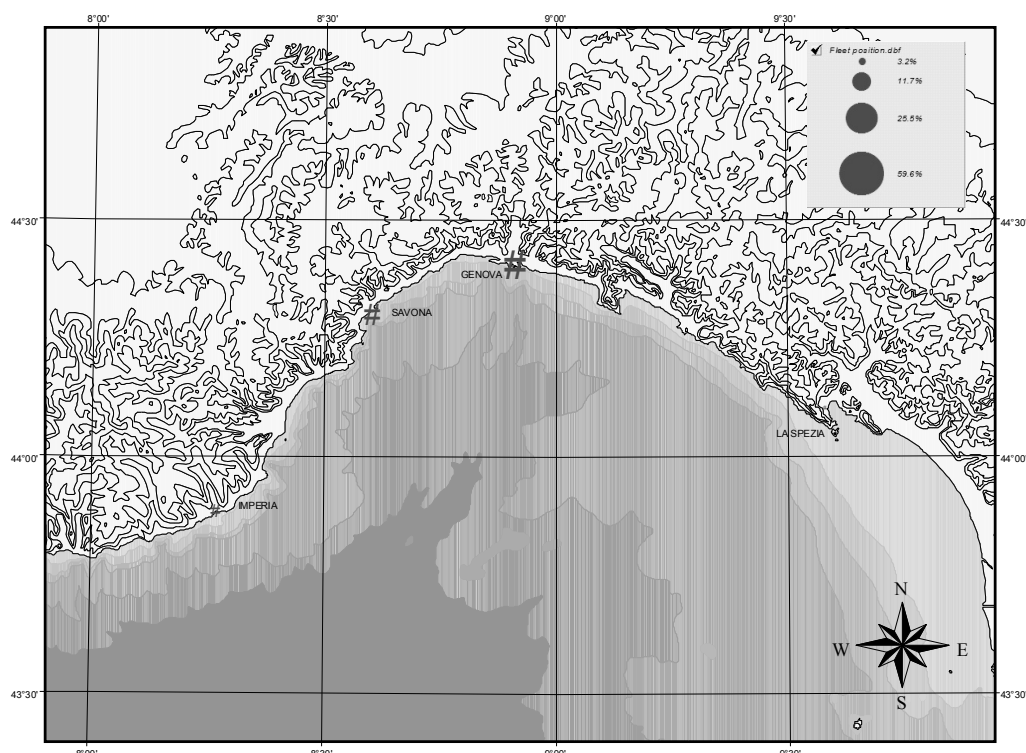



Figure 21. Transparent goby fleet distribution in Liguria

The fleet (Table 10) is composed of small vessels, with an average gross tonnage value (GT) for every Marine District which ranges from 1 (La Spezia) to 1.72 (Genoa) and a very reduced average engine power (kW), from a minimum of 11.27 kW (La Spezia) to a maximum of 34.08 kW (Genoa) (table 10).

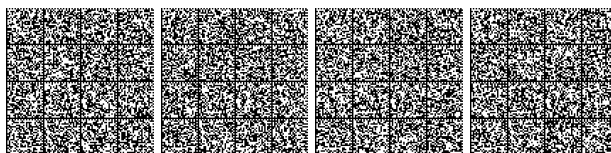



Table 10 – Gross tonnage (GT) and engine-power (kW) as average and total values for vessels authorized to fish transparent goby in Liguria

	GT		***kW***	
	Average	***Total***	***Average***	***Total***
Genoa	1,72	96,30	34,08	1908,20
Savona	1,58	38,00	21,27	510,42
Imperia	1,27	14,00	16,28	179,08
La Spezia	1,00	3,00	11,27	33,80

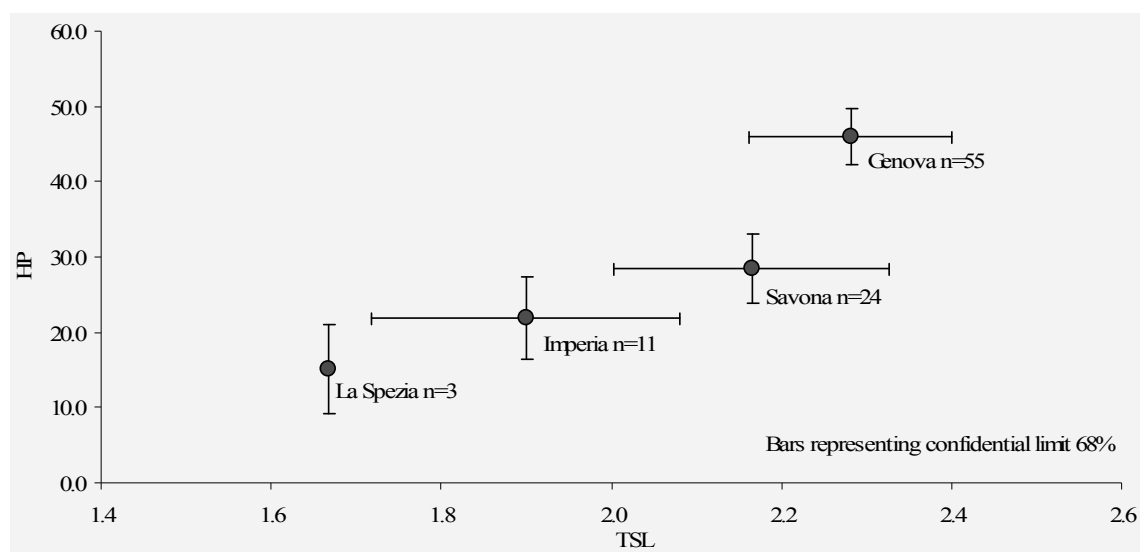



Figure 22 - Characteristics of fleet authorized to fish the transparent goby in Liguria

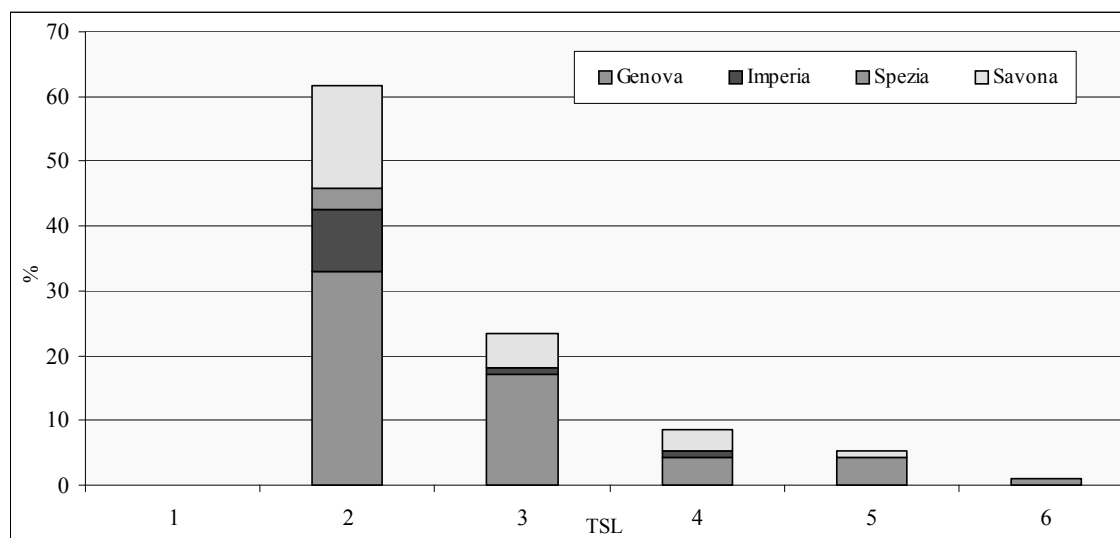



Figure 23- Dimensional structure (tonnage) of fleet authorized to fish the transparent goby in Liguria

Fishing habits of the Ligurian vessels substantially differ from those of Tuscany ones. In fact a large majority of active boats works only during the morning (frequently carrying out 3-4 hauls in few hours) and land the product for a quick selling and immediate use of the fish at the top of its organoleptic properties. The high prize so achieved (60-70 euros/kg) acts in compensation of small fished quantities.

Table 11– List, registration number, name and structural characteristics of the 79 boats authorized to fish transparent goby in Liguria (Regional database update to 2010)

N°	UE CODE	NAME	IT CODE	GT	KW	N°	UE CODE	NAME	IT CODE	GT	KW
1	4134	NOI TRE'	00GE08398	1	42	**48**	4273	GABRY	03GE00995	3	48
2	4169	NOÈ II	00GE08635	2	63	**49**	4274	MAMI	03GE00997	1	18.4
3	4178	ADUA II	00GE08663	1	26	**50**	4281	SIMONE II	03GE01018	2.19	47
4	4183	ZIGUELA	02GE02225	1	16.64	**51**	4282	FABRIZIO	03GE01021	1	26
5	4222	IPPOFIOR	03GE01057	2	84	**52**	4378	SWING	00GE08801	1	25
6	4257	ALBATROS	15GE00667	3	56	**53**	25072	ALBATRO	00GE08772	1	19
7	4264	PAOLO	03GE00912	3	16	**54**	25262	RECCHELIN	03GE01078	1	31
8	4278	SELEMAR	03GE01013	2	58.8	**55**	15477	ALGIAN	05GE00086	1	7.36
9	4287	ANDREA II	03GE01073	2	50	**56**	4890	STELLA	00IM01096	3	52.94
10	4290	DANIELA	04GE01456	1	41	**57**	4971	NAZZARENO	01IM01764	1	18.39
11	4292	CARLA II	03GE01044	2	95.6	**58**	4999	FREEDOM	02IM00372	1	14.5
12	4296	GIOVANNI	03GE01052	2	48.5	**59**	5022	ROCCO	02IM00314	1	14.7
13	4302	PIERO	04GE01354	2	23.52	**60**	5024	SILCRI	02IM00328	1	17.6
14	4311	BACOCRO	04GE01426	3	62	**61**	5030	MORENA	02IM00359	1	8.83
15	4314	ANTONIO PADRE	04GE01455	1	29.4	**62**	5026	ADA	02IM00340	1	3.68
16	4330	SUSY II	17GE00671	1	33	**63**	5029	SANTA LUCIA	02IM00357	2	17.64
17	4334	DUE GEMELLI	05GE00035	1	24	**64**	5031	NONNA CARMELA	02IM00360	1	11
18	4350	ANGELA	05GE00070	1	16.93	**65**	5032	SAN MARCO	02IM00361	1	12.5
19	4368	RAFFAELINO	17GE00111	1	11	**66**	18478	GABBIANO I	02IM00369	1	7.3
20	4370	SILVIA MADRE	17GE00620	5	47.8	**67**	5020	ANTONIETTA II	04SP00434	1	6.3
21	4377	DELFINO	17GE00653	1	29.41	**68**	14737	CONCHIGLIA	11SP00805	1	17.6
22	4379	SANTA TERESA	17GE00657	1	14.7	**69**	4403	MARIA	05SP00431	1	9.9
23	4380	LEPANTO	15GE00669	1	7.5	**70**	15419	LO SQUALO	02SV05078	1	11
24	5407	ALGA	05GE00073	1	33	**71**	15221	CARLA	00SV04503	1	5
25	14660	LEONESSA	17GE00667	1	53	**72**	15265	MILLY	00SV04774	1	13.2
26	15213	S. PIETRO IV	00GE08803	2	21	**73**	15268	ELY GIO	00SV04786	1	16.2
27	15263	BONACCIA	00GE08859	4	63.5	**74**	15285	AZZURRA	00SV04819	1	8.8
28	15346	ELENA	18GE00037	1	16	**75**	15293	AGOSTINO PADRE	00SV04835	2	22
29	17726	MANUEL	04GE01441	1	17.6	**76**	15300	SBIGIA III	00SV04845	2	68.5
30	19054	GIULIANA II	07GE00348	2	62.5	**77**	15311	GIANNA	00SV04865	3	30.88
31	19233	FILOMENA II	00GE08709	1	14.5	**78**	15332	SAN GIOVANNI	00SV04899	4	61
32	19512	IRREQUIETO	00GE08436	4	52.92	**79**	15370	MARTIN II	01SV01356	1	24
33	20684	GIAN MARIO	00GE08822	1.11	0	**80**	15394	GIACOMO	02SV05007	1	7.35
34	25031	FILIPPO	00GE08769	1	16.5	**81**	15422	CARLIN PADRE	02SV05081	1	18.38
35	25311	LAURA	05GE00100	1	14.7	**82**	15426	BETTINA II	02SV05088	1	17.65
36	26155	CORSARO	00GE08811	4	40.5	**83**	15472	LUCIA	04SV01770	1	24.3
37	26417	PAGAN II	03GE01084	4	63.2	**84**	15505	CRISTIANO	04SV01843	3	14.7
38	26848	SAN PIETRO II	19GE00012	1	20	**85**	15515	PUE' FRANCESCO	06SV00325	2	7.35
39	27067	GIUVANIN	00GE08856	1	22.7	**86**	18538	GIULIN	00SV05012	3	47
40	27096	ARIANNA	00GE08858	2	20.59	**87**	23418	SAN GIORGIO	01SV01398	1	29.48
41	27375	MARTINA	17GE00682	2	20.6	**88**	26176	NICOLA ANTONIO	04SV01877	2	22.8
42	25483	ELVIS	17GE00673	2	58.8	**89**	15339	SAN FRANCESCO	00SV04911	2	13.8
43	4131	SANPEY	00GE08387	2	53	**90**	15202	GENTILE	00SV04424	1	7.3
44	4223	ALICYA	03GE01059	2	32.3	**91**	15423	THOMAS	00GE08800	1	26,47
45	4245	GIOLA	03GE01049	2	60	**92**	15376	ZAZI II	04SV01879	1	16.19
46	4248	ANDREA	03GE01064	1	14.5	**93**	15403	DAVIDE	02SV05044	1	14.71
47	4263	MIN	03GE00785	1	5	**94**	25936	ALEX IV	02SV05082	1	14,71

3.5 Bycatches

The presence of other fish species in the catch by seine is entirely fortuitous as already reported by Auteri *et el.* (1989). In fact the seine can be considered a highly selective type of net (Relini et al., 1998), as demonstrated by the fact (see table below) that transparent goby makes up 99% in number and over 90% in weight of the total catches counted in the entire fishing season (Auteri *et al*., 1996).

Table 12 - Number of individuals of secondary species observed in seine catches

catture accessorie	novembre	dicembre	gennaio	febbraio	marzo	Totale
Alloteuthis media	0	15	1	2	0	18
Coris julis	0	0	0	20	0	20
Dentex dentex	0	1	0	0	0	1
Diplodus sargus	0	0	1	0	0	1
Diplodus vulgaris	0	0	0	1	0	1
Loligo vulgaris	0	24	2	0	0	26
Mullus barbatus	4	7	0	0	0	11
Pagellus acarne	19	49	166	237	0	471
Pagellus erythrinus	0	33	13	0	0	46
Pseudaphya ferreri	0	0	0	0	27	27
Sepia officinalis	0	1	0	0	0	1
Spicara maena	10	0	0	0	0	10
Symphodus cinereus	0	0	0	3	0	3
Symphodus roissali	0	0	0	35	0	35
Trachurus mediterraneus	0	0	2	0	0	2
Totale complessivo	**33**	**130**	**185**	**298**	**27**	**673**
Aphia minuta	**420000**	**25000**	**8000**	**3000**	**720**	**456720**
% altre specie	**0,01%**	**0,52%**	**2,31%**	**9,93%**	**3,75%**	**0,15%**
peso del rossetto (g)	50500	27500	17750	6600	100	102450

During commercial fishing expeditions the secondary species caught most often is the Axillary seabream (*Pagellus acarne*), one reason being its gregarious behaviour similar to that of the transparent goby. The specimens usually measure from 3 to 6 cm, especially in January and February. Nonetheless it should be pointed out that, considering the fishing technique used and the practically null commercial value, these individuals are usually thrown back alive into the sea.

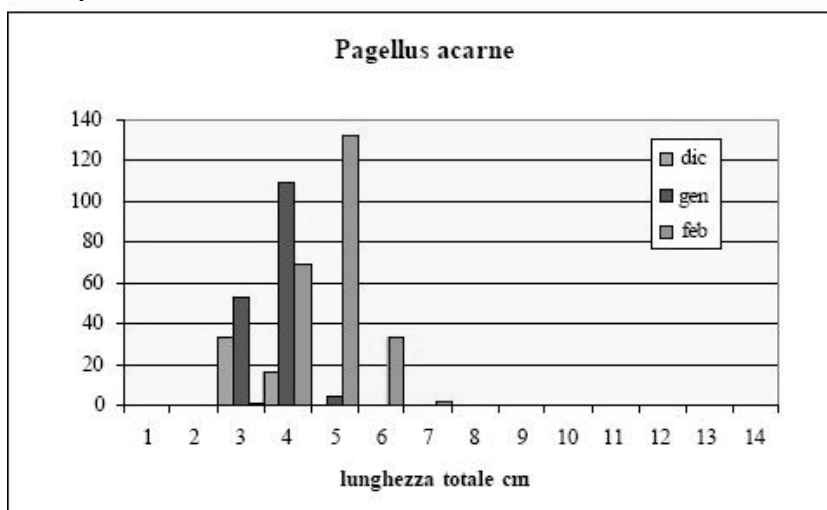



Figure 24 - Size distribution of bycatch of P. acarne *using the seine*

The Common pandora *(Pagellus erythrinus*) has also been found in bycatches and its size ranges from 3-4 cm to 25 cm TL, usually in December and January, but its numbers are entirely negligible (a few dozen specimens).

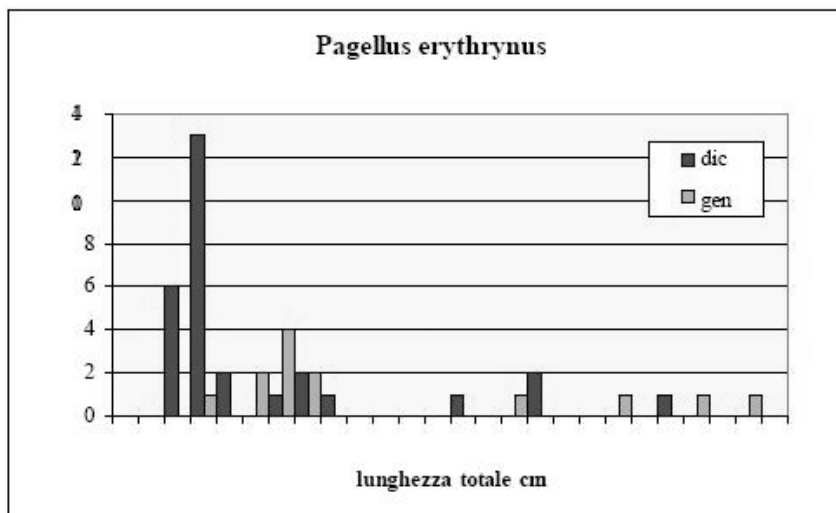



Figure 25 – Size distribution of bycatch of P. erythrynus *using the seine*

Other gobies are occasionally caught in tiny amounts, such as *Cristallogobius linearis* and *Pseudaphya ferreri*; according to the fisherman, their presence reduces the commercial value of the transparent goby catch.

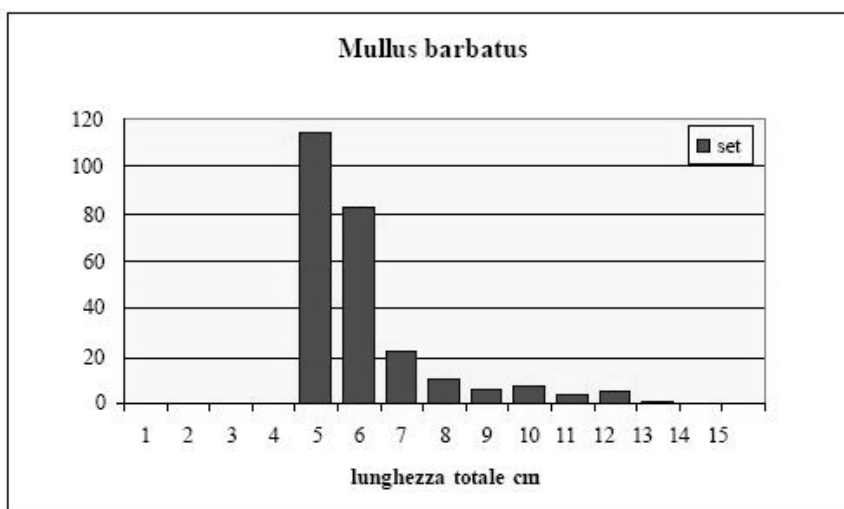
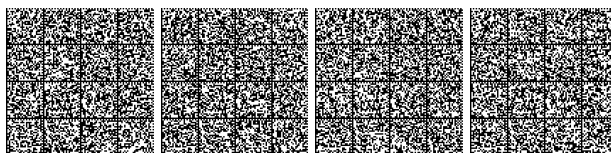



Figure 26 – Size distribution of M. barbatus *caught by seine in the summer*

It should be pointed out that the seine, is potentially able to catch "marine juveniles as well as other species (the figure below shows the size distribution of mullet, which is usually not found in the months when transparent goby is being fished. In winter the impact of this type of fishing on the other species is

therefore practically null and studies conducted over years have shown that the presence of bycatches has always been lower than 1% (Auteri *et al*., 2000).

In table 13 is presented a list of by-catches species during the fishing activity targeting to transparent goby along the Ligurian coast (Relini, 1997). Catches refer to the period from November to January, when the fishing season of transparent goby have the maximum effort; in fact from February onwards the fishing activity have as main target the juveniles of *S. pilchardus* (so called "bianchetto"). It's demonstrated that the boat seine can be considered a highly selective type of net. The transparent goby makes up 97-99% in number of the total catches and over 90% in weight in the entire fishing season. In January, the highest percentage of by-catches observed (2.7%) is due to the presence of a second species of pelagic gobiid, *Crystallogobius linearis* marketed and locally sold as crystal goby or "bianchetto di fondo of Portofino" (distinguished from the young stages of clupeids, *Sardina pilchardus*) and it is considered a local excellence of the Portofino promontory where it is caught alone or in association with the transparent goby (*A. minuta)*. However, by catch species are usually still alive, given the short duration of the hauls, and are generally released into the water after recovery. The number of juveniles of other species caught with the "seine" net is always less than 1% in number, and consist mainly of annular seabream (*D. annularis*), striped seabream (*L. mormyrus*), black seabream (*S. cantharus*) and "bianchetto" (juveniles of *S. pilchardus*).

Table 13 – By catch species (number) monitored in Liguria during a transparent goby fishing season.

By catch species	November	December	January
Atherina sp.	100	0	0
Boops boops	2	4	0
Crystallogobius linearis	0	0	81155
Dentex dentex	0	0	1
Loliginidae	3	1	8
Mullus barbatus	1	0	0
Mullus surmuletus	0	12	0
Pagrus pagrus	0	0	2
Sepiola sp.	4	0	0
Serranus scriba	0	0	1
Spicara maena	5	1	0
Spicara smaris	0	3	1
Syngnathus sp.	27	0	0
Syngnathus typhle	2	0	0
Synodus saurus	0	0	1
Trachurus sp	2	0	0
Trachurus trachurus	0	2	25
Juveniles			
Diplodus annularis	13	0	0
Lithognathus mormyrus	3	0	0
Sardina pilchardus	0	0	250
Spondyliosoma cantharus	1	0	0
Total catch	***81727***	***780686***	***3010617***
***Aphia minuta* (N)**	**81564**	**780663**	**2929173**
***Aphia minuta* (g)**	**7300**	**89200**	**171682**
% Other species	**0.199**	**0.003**	**2.705**
% Juveniles species	**0.021**	**0.000**	**0.008**

3.6 Biomass estimation of transparent goby stock

The available biomass estimation of transparent goby stock refers to Tuscany area.
The transparent goby species is intensely exploited in a relatively short period of time and within a few months there is a conspicuous decrease in its abundance. This is why there has been an attempt to use the classic Leslie-De Lury depletion model as described in Baino *et al*.(2001).
By means of a simple regression of the CPUE, regarding the cumulative catches, we can determine the intercept on the X-axis representing the biomass estimation of the virgin stock (B0) at the beginning of the fishing season.
CPUE at the beginning of the fishing season can vary from 10-50 kg/day/boat and the depletion model applied to the area suggests the presence of an initial stock (B_0) of 40 to 60 tons for each year.
During the period analyzed (1990-1996) the number of active boats varied from 20 to 45 per month, though the overall fishing effort of the entire fleet was more or less constant at around 1000 fishing days for each year. On the other hand the catches were extremely variable from one year to the next, ranging from 9 tons per year in the 1994-95 season to 29 tons per year in the 1992-93 season.

This significant variability is explained by the difference in the period in which the recruitment peak occurs. When recruitment is concentrated in spring or late autumn, during the actual fishing season most of the specimens of transparent goby have already exceeded the size in which the organisms are more vulnerable to the gear (20-35 mm) resulting in commercial catches that are much smaller.

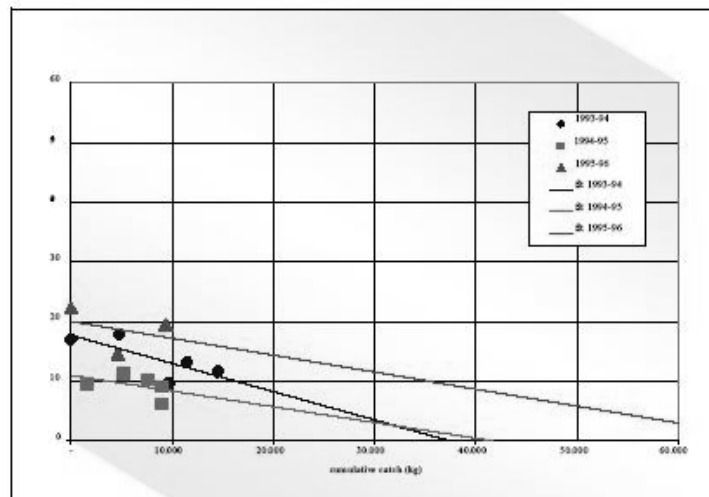



Figure 27 – Depletion model for the years of small catches

On the contrary, a strong recruitment concentrated in summer is favourable to commercial fishing because during the fishing period many specimens are smaller than 30 mm, and therefore vulnerable to the gear. Naturally this leads to larger catches.

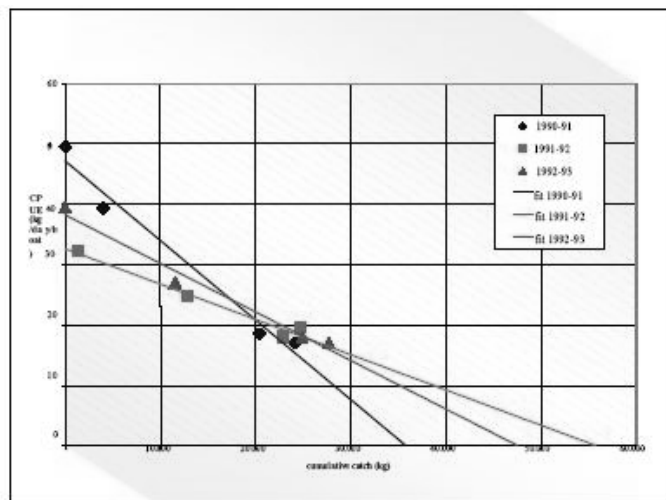



Figure 28 – Depletion model for the years of large catches model for the years of large catches

3.7 Socio-economic assessment

In GSA 9 transparent goby fishing with the seine is a tradition that has been consolidated since the 1970s. For the years when this technique was directly monitored in Tuscany (from 1990 to 2009) we see a situation that is extremely stable and consists of approximately 50 boats and over 100 fisherman; in Liguria, the number of boats is 79 for about 160 fisherman involved in transparent goby fishing.

With regard to Tuscany, only a small portion of the annual catches of 10-30 tons are sold on the Tuscan market (approximately 20%) while the lion's share is sent to Liguria where, much like whitebait, it is considered one of the most prized and sought-after fish products: in certain periods of the year it reaches prices that in other areas of Italy are unthinkable. Today in some areas of Liguria transparent goby can cost as much as €70 per kilo on the retail market with peaks of over €100 per kilo.
Especially during Christmas the price of transparent goby shoots up even higher than €40 per kilo (price invoiced to the producer) and the final price to the consumer in the fish shop is €120 per kilo.
Mennella (2009) reports the economic profile of a shipbuilding Livorno cooperative which built 17 small-scale boats fishing transparent goby since before 1992. The table below shows that the total annual revenue from transparent goby fishing is much higher than that of other species fished during the periods when transparent goby fishing is prohibited or in the same periods from boats that alternate transparent goby fishing with that using other types of gear, essentially trammels and long lines.

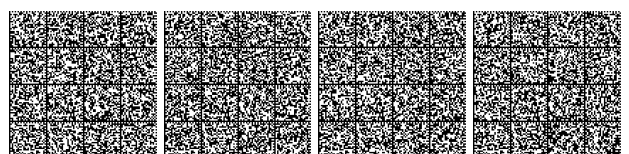



Table 14 - Economic prospects for small-scale fishing (from Mennella, 2009)

ANNO	TOTALE CATTURE IN €	ROSSETTI CATTURATI IN €	ALTRE SPECIE IN €	% VALORE ROSSETTI SU TOTALE CATTURE
1992	436.000,00	93.598,00	342.402,00	21,47
1993	480.845,00	103.866,00	376.979,00	21,60
1994	336.503,00	50.775,00	285.728,00	15,09
1995	467.430,00	79.954,00	387.476,00	17,11
1996	412.487,00	115.386,00	297.101,00	27,97
1997	284.571,00	131.482,00	153.089,00	46,20
1998	509.662,00	131.831,00	377.831,00	25,87
1999	640.550,00	194.706,00	445.844,00	30,40
2000	455.607,00	120.920,00	334.687,00	26,54
2001	508.698,00	246.224,00	262.474,00	48,40
2002	485.125,00	198.015,00	287.110,00	40,82
2003	358.571,00	174.595,00	183.976,00	48,69
2004	449.202,00	315.344,00	133.858,00	70,20
2005	430.363,00	233.014,00	197.349,00	54,14
2006	519.467,00	160.978,00	358.489,00	30,99
2007	491.667,00	252.658,00	239.009,00	51,39
2008	541.156,00	210.779,00	330.377,00	38,95
TOTALI	**7.807.904,00**	**2.814.125,00**	**4.993.779,00**	**36,04**

Socio economic reasons for continuing transparent goby fishing with the traditional small boat seine in the period from November to March are summarized as follows.
- This seine is not harmful to the marine environment;
- In the months when transparent goby is fished, there is a reduction in fishing effort with other fishing gears (mainly gillnets), resulting in a lower fishing pressure on other species.
- When fishermen are working during winter close to the shore, their safety conditions are improved;
- Considering the higher commercial value of the transparent goby, fishermen work fewer hours, thereby improving their quality of life;
- A large portion of the total sales of small-scale fishermen comes from the fishing of transparent goby: without this revenue, the income of their enterprise would be insufficient to survive;
- The fish marketing chain in Tuscany and Liguria is closely linked to this fishery to the product and to the traditional local Ligurian cuisine
- Fishing transparent goby with the seine in Tuscany and Liguria represents one of the highly specialized trades of ancient traditions.

According to the data provided by trade associations and cooperatives, for an entire fishing season (from November to March) the revenue is around €500,000 and is a significant source of income for small-scale fishermen.

Table 15 - First sale price of transparent goby in euros (from Mennella, 2009)

ANNO	Prezzo medio al KG
2002	**27,77**
2003	**23,7**
2004	**20,79**
2005	**24,59**
2006	**30,65**
2007	**21,9**
2008	**24,89**

Much like other special types of fishing in the Mediterranean, transparent goby fishing is considered extremely important because it is lucrative (it allows adequate earnings for one-income families whose head of family practices fishing on the coast), and because of its deep roots in cultural heritage.
The following tables show the major socio-economic indicators of Tuscan and Ligurian small-scale fishing referring to the boats that fish transparent goby.

Table 16 - CPUE of Tuscan and Ligurian total small-scale fishing (Source:Mipaaf-Irepa)

	2000	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**
	Tuscany								
Annual catches per boat (tons)	6.8	5.1	3.9	3.8	2.6	2.3	2.1	2.5	1.8
Daily catches per boat (kg)	38.2	32.7	27.9	21.8	20.7	19.,7	23.7	26.4	28.1
	Liguria								
Annual catches per boat (tons)	6,0	5,3	4,3	4,8	4,7	3,9	3,3	3,3	2,9
Daily catches per boat (kg)	40,2	26,6	22,7	38,0	35,5	30,3	23,6	25,9	25,8

Table 17 – Catches and revenues of Tuscan and Ligurian total small-scale fishing (year 2006, Source Mipaaf-Irepa)

	Tuscany	**Liguria**
total catches 2006 (tons)	994	1.408
number of boats	473	435
% of total catch in the region	9%	28.7
revenues (millions of euro)	10.9	17.32
% of total revenues in the region	22.1	39.0
average price (euro/kg)	11.0	9.07

Table 18 - Profit and loss account in millions of euro regarding total small-scale fishing in Tuscany and Liguria (year 2006, Source Mipaaf-Irepa)

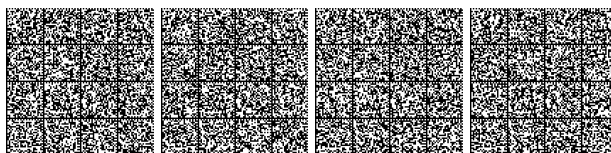
	Tuscany	**Liguria**
Revenues	10,91	17,4
Go-Between costs	3,18	4,9
Added value	7,73	12,5
Labour costs	3,17	5,1
Gross profit	4,56	7,4

The annual average catch per small-scale fishing boat in Tuscany in 2006 is 2.1 t/boat/year. Since the total catch of transparent goby in the same year in Tuscany is 20 tons (caught by 45 boats), the average annual catch of transparent goby per boat is 0.44 t/ boat/year. Therefore, for boats that fish transparent goby, this makes up 21% of their total yearly catches of all species and the economic value is 38% of their total annual revenue.

Upon analysis of the statistic distribution of transparent goby fishing yields in Tuscany (CPUE expressed in kg/day/boat on the table below) we can identify the safety thresholds for monitoring this resource and the impact of fishing.

Table 19 – Annual fishing yields in kg/day/boat

Tuscany			
CPUE	**Year**	**Cumulative frequency**	
9.9	1994	10	3%
14.1	2006	24	7%
14.6	1993	39	11%
15.4	1997	54	15%
15.4	1996	69	19%
16.9	2003	86	23%
17.2	2002	103	28%
18.8	2001	122	33%
19.0	2000	141	38%
20.1	1995	161	44%
20.8	1999	182	50%
21.6	1998	204	55%
21.6	2005	225	61%
24.5	2004	250	68%
25.6	1992	275	75%
26.5	1991	302	82%
30.3	2008	332	90%
35.3	2007	368	100%

Using the cumulative distribution of CPUE, in Tuscany, the average is 20.8 and the percentile at 25% corresponds to 17 kg/day/boat: this value is considered the minimum limit to not go under for three consecutive years in order to have sufficient guarantees for the resource.

CHAPTER 4 - CATCHES OF TRANSPARENT GOBY

4.1 Catch variations over time

Tuscany

The average annual fishing effort (total number of working days per boat) is 1040 days, with a minimum number of days equal to 773 in 2006 and a maximum of 1417 in 2004. An examination of the activity shows that 47% is accounted for by the fleet of Livorno, 22% that of Vada, Piombino 11%, Porto S. Stefano 11% and Follonica 8%.
The total daily catches present fluctuating values with a minimum of 0.5 kg in January 2008 to a peak of about 1850 kg in November 2007. The average catch per fishing day is 180 kg/day. Consequently, as mentioned above, with the average number of active boats daily being nine, the average catch per boat per day is about 20 kg.

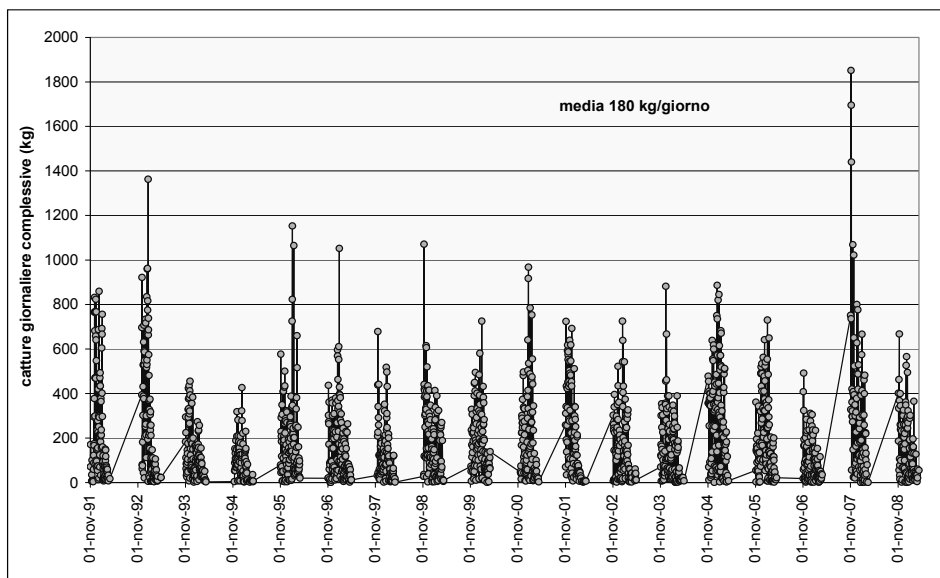



Figure 29 - Total transparent goby catches per day for the period 1991-2009

Considering instead the annual catches, the average was 20.4 tons/year with minimum values recorded at only 9 tons in 1994 and 11 tons in 2006 and maximum values equal to 34.8 tons in 2004.

The highest annual catch values are in the area of Livorno, while very low values were registered for Piombino and Porto S.Stefano in particular: variability between years and the fishing areas is still high, as summarized in the following tables and figures.

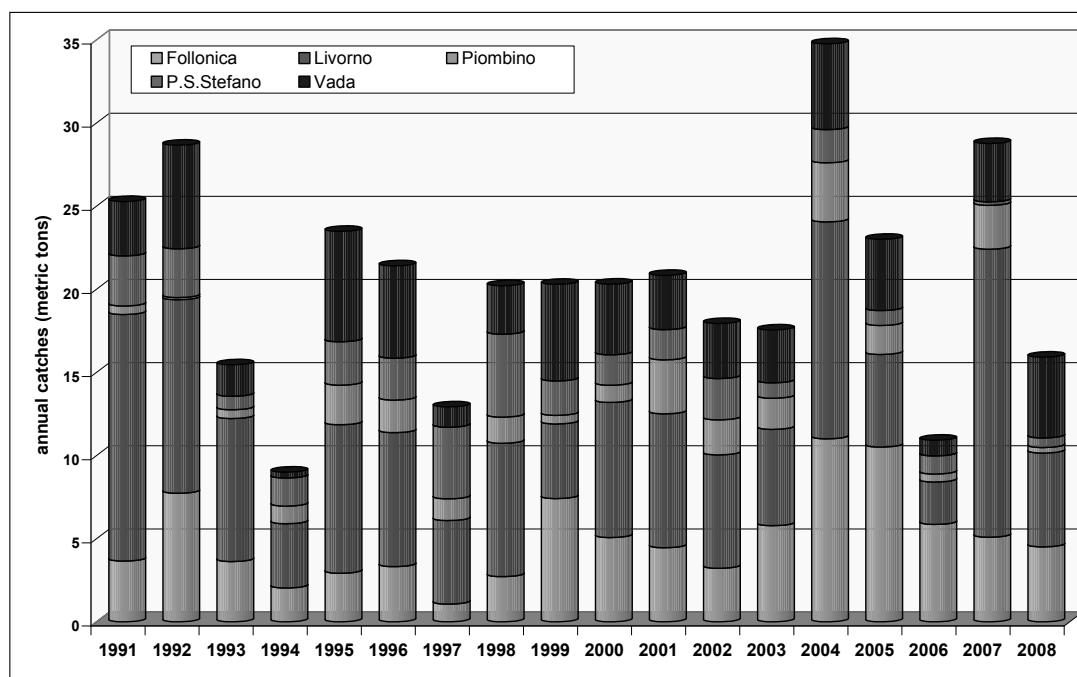



Figure 30 - Total annual transparent goby catches for the period 1991-2009

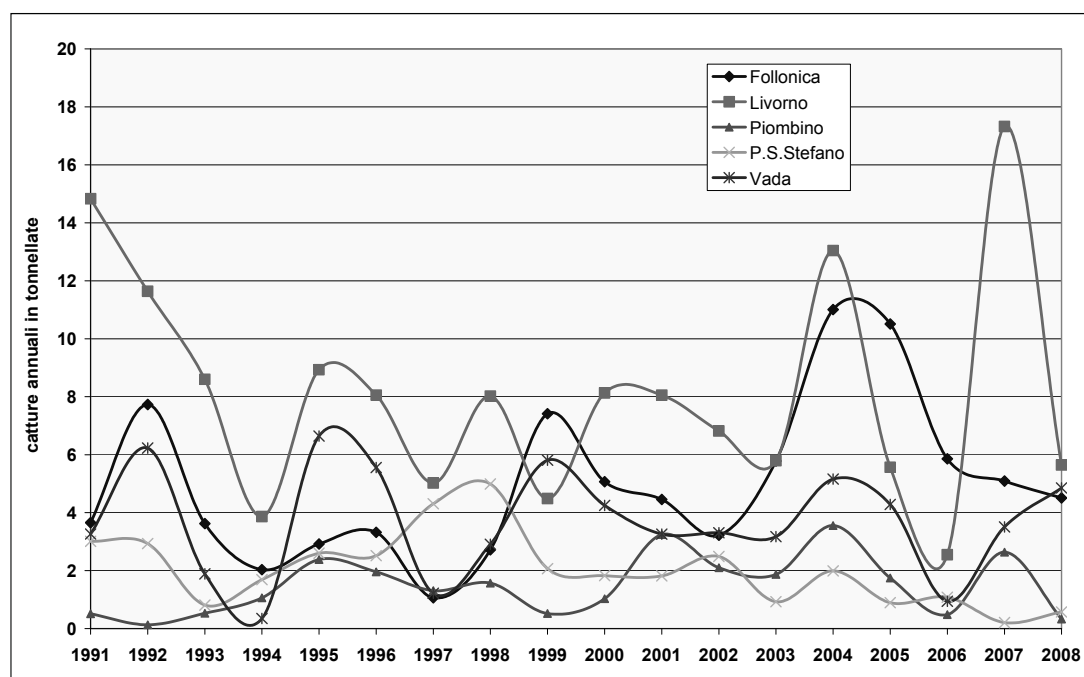



Figure 31 - Fluctuations in total annual transparent goby catches for the period 1991-2009

Table 20 - Annual catches in tons by fishing area

	Follonica	Livorno	Piombino	P.S.Stefano	Vada
1991	3,66	14,83	0,51	3,01	3,27
1992	7,73	11,64	0,13	2,93	6,23
1993	3,63	8,60	0,53	0,81	1,89
1994	2,03	3,87	1,06	1,69	0,35
1995	2,92	8,93	2,39	2,60	6,64
1996	3,32	8,06	1,96	2,52	5,56
1997	1,07	5,02	1,31	4,31	1,22
1998	2,72	8,02	1,57	4,99	2,91
1999	7,41	4,49	0,52	2,07	5,81
2000	5,07	8,13	1,03	1,83	4,25
2001	4,46	8,05	3,25	1,82	3,26
2002	3,22	6,82	2,10	2,49	3,31
2003	5,78	5,79	1,87	0,93	3,18
2004	11,01	13,04	3,56	1,99	5,16
2005	10,51	5,57	1,75	0,89	4,28
2006	5,86	2,55	0,48	1,08	0,94
2007	5,09	17,32	2,64	0,21	3,51
2008	4,51	5,64	0,33	0,58	4,85

The trend in catches per unit of effort, (CPUE), expressed here as kg/day/boat, is one of the most widely used tools for assessing the state of exploitation of a resource, especially when information is limited. Starting with data on the quantities of transparent goby landed and of the fishing effort has made it possible to define the trend in CPUE for the period analyzed, under various grouping criteria, as shown below.

Table 21 - CPUE in kg of catches/day/boat by area

	Follonica	Livorno	Piombino	P.S.Stefano	Vada
1991	20,1	28,3	24,3	27,9	27,4
1992	22,0	24,8	9,4	32,2	32,3
1993	10,4	17,1	27,8	11,6	16,4
1994	8,0	9,4	7,3	24,1	12,4
1995	14,5	20,7	12,2	20,0	31,8
1996	10,5	18,1	9,6	20,6	18,2
1997	9,8	12,8	11,6	35,9	11,3
1998	13,9	21,3	15,7	50,9	17,5
1999	20,0	18,1	11,0	19,1	28,6
2000	13,9	25,3	18,4	12,6	23,1
2001	19,6	20,0	16,0	19,1	18,1
2002	17,4	17,6	14,9	16,1	18,8
2003	15,7	18,0	16,4	12,0	20,4
2004	23,8	27,2	19,3	15,6	31,7
2005	22,4	20,9	15,6	38,8	22,3
2006	13,7	14,0	9,9	20,1	16,0
2007	26,2	39,7	32,6	11,5	40,3
2008	50,1	67,2	25,5	52,4	63,0
media	18,4	23,4	16,5	24,5	25,0

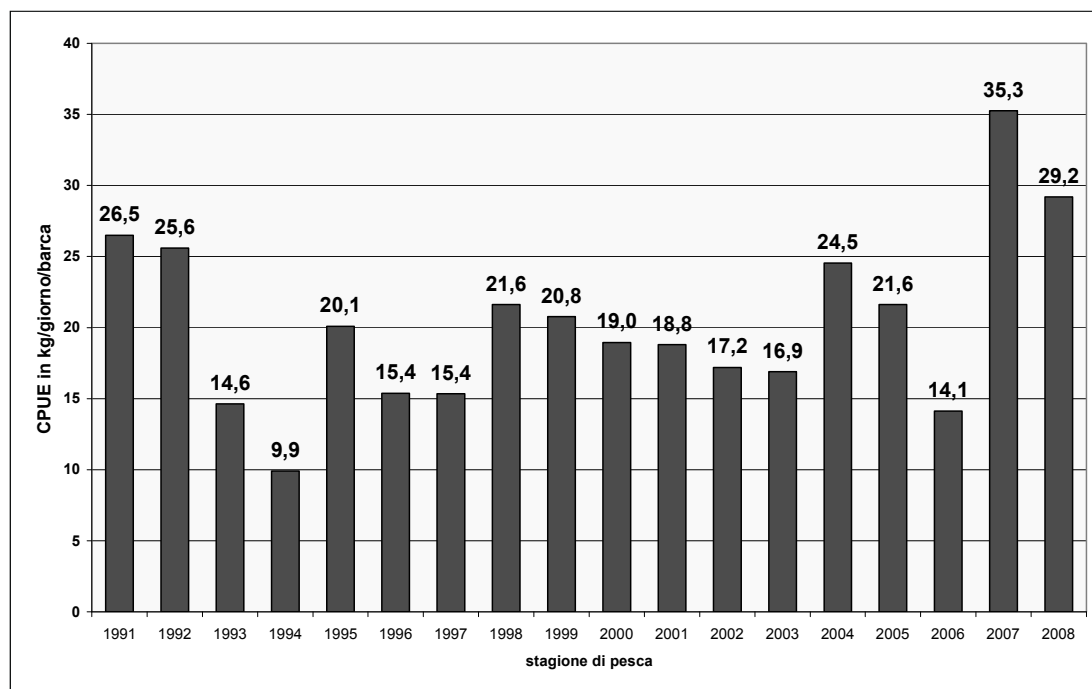



Figure 32 - CPUE in kg of catches/day/boat by fishing season

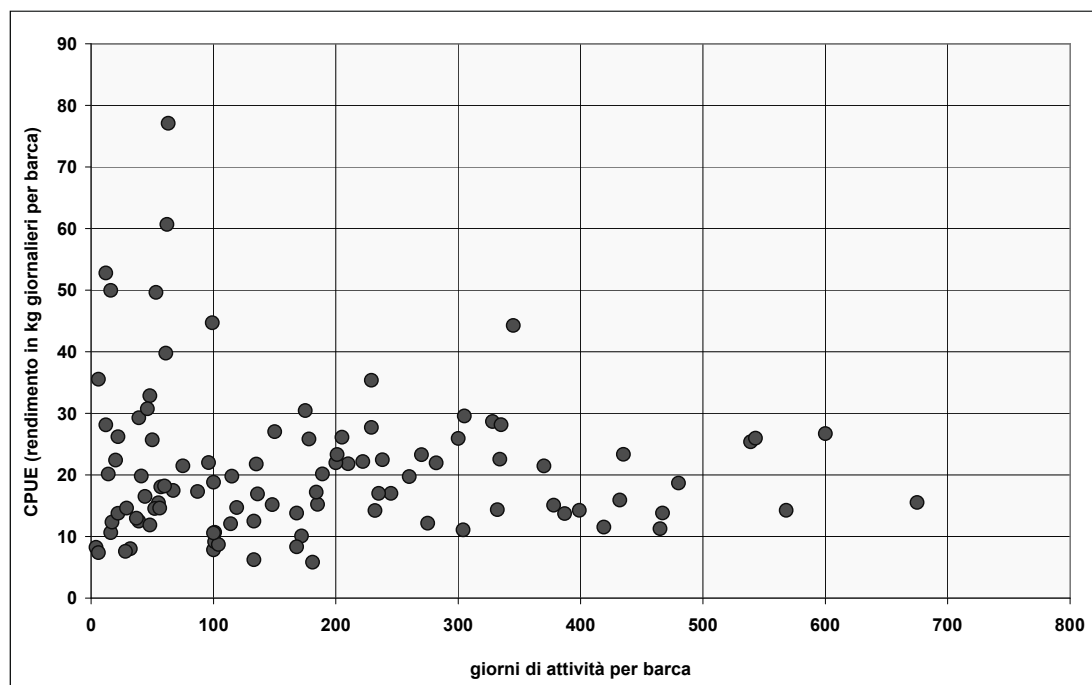



Figure 33 - Correlation between average CPUE per boat and days of activity for the period 1991-2009

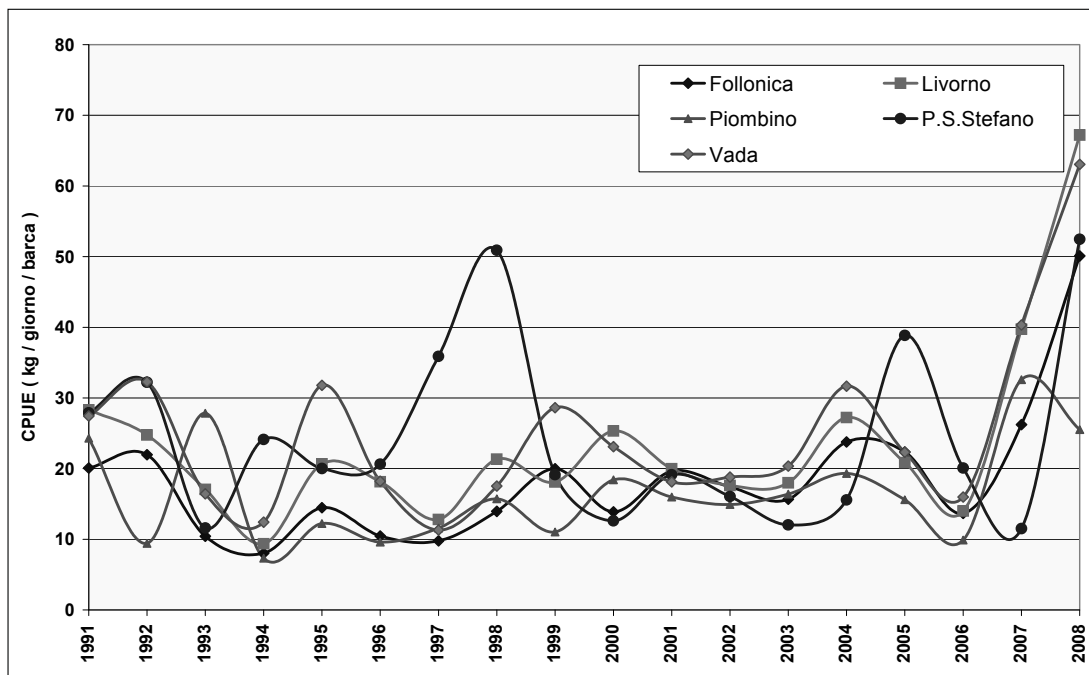



Figure 34 - CPUE in kg of catches/day/boat by season and fishing area

The highest recorded CPUE values are in 2008 with 51.7 kg/day/boat, while minimum values were recorded in 1994 with only 12.3 kg/day/boat: the overall average of the period indicates daily catches per boat equal to 21.6 kg.

An analysis of the CPUE values shows that in terms of yield the more productive areas appear to be Vada at 23 kg/day/boat and Porto S. Stefano at 22 kg/day/boat. The area of Livorno, again in terms of yield, presents average values of 20 kg/day/boat. The areas that have lower yields, and are therefore less productive, are Follonica and Piombino at 16 kg/day/boat and 14 kg/day/boat respectively.

Also on the basis of area distinction, 38% of the fishing activity is in the area of Livorno. Porto Santo Stephen has high yields but only 10% of the fleet is active there, which is, moreover, mostly the local fleet. 26% of the activity takes place in Follonica and 15% in Vada although, as stated above, the yields are significantly higher in Vada.

The comparison of transparent goby catches made in Tuscany and around the Balearic Islands in the last 8 years is particularly interesting (table and figures below). While 45 vessels operate in Tuscany, compared to 120 boats found in the Balearic Islands, the total catch is approximately one-third higher, indicating a particularly favourable productive situation for Tuscany.
Furthermore, the similarity of trends from 2003 to 2007, that have very large and consistent fluctuations, may support the hypothesis that fluctuations in abundance are determined by climatic conditions on a Mediterranean scale, as there is no way to predict the composition of transparent goby stock over that amount of time.

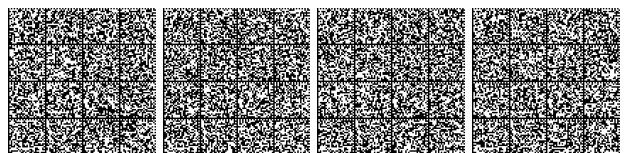



Table 22 - Annual catches of transparent goby in kg made in Tuscany and the Balearics

anno nominale	stagione di pesca	Baleari	Toscana
2001	2001-2002	1.041	20.835
2002	2002-2003	6.152	17.941
2003	2003-2004	15.417	17.550
2004	2004-2005	20.624	34.762
2005	2005-2006	9.875	23.002
2006	2006-2007	3.688	10.920
2007	2007-2008	11.060	28.767
2008	2008-2009	36.391	15.916
	media	**13.031**	**21.212**

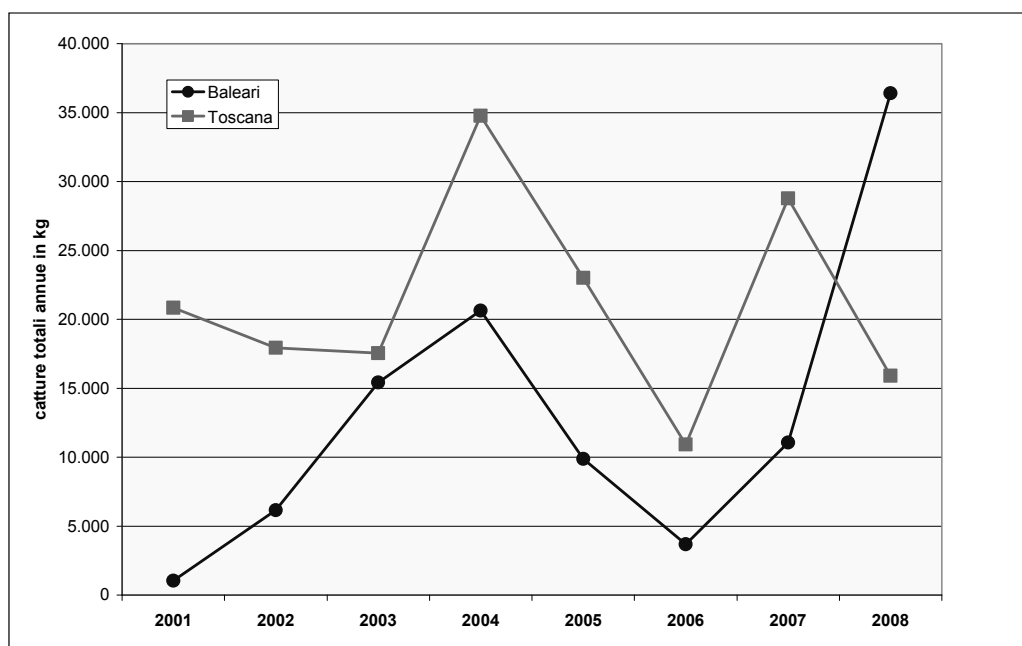



Figure 35 - Comparison of annual catches of transparent goby made in Tuscany and the Balearics

4.2 Statistical validation

The statistics of transparent goby catches in Tuscany are fundamentally based on the daily catch forms completed by each boat between the years 1991-2009. Altogether there are 18,229 catch data with an average of 20.12 kg, median of 14 kg and mode of 10 kg. The high kurtosis (35.09) and asymmetry (4.22) values indicate that the data are lognormal, as shown in the following distribution, and characteristic of this type of data (fig. 36).

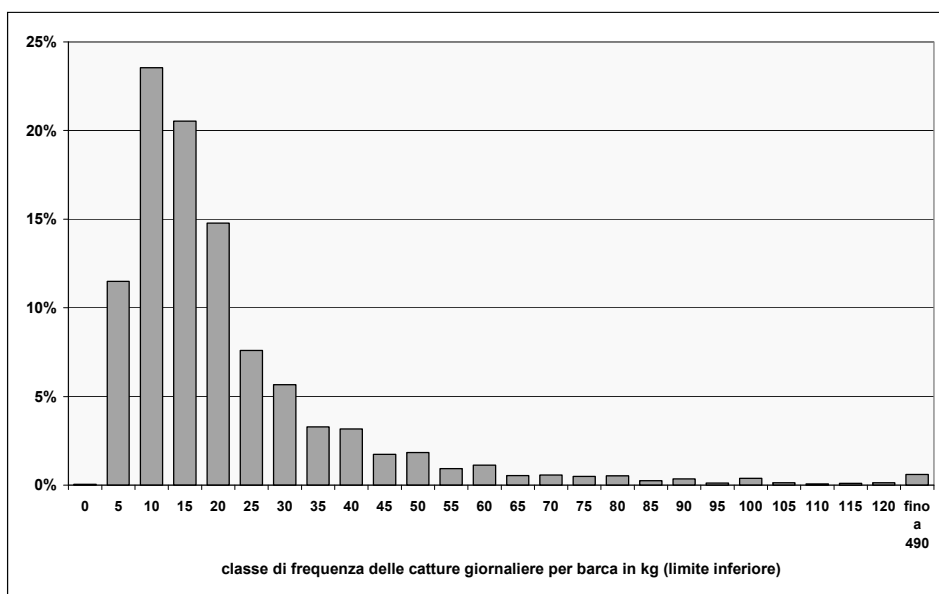



Figure 36 - Statistical distribution of transparent goby catches (n = 18,229)

In the Ligurian a comparable time series of CPUE data is not available, because there is not a monitoring network similar to that of Tuscany, so, the following statistics of transparent goby catches are based on daily observations carried out on board of professional vessels and at landings in the framework of three projects. Two projects were promoted by MiPAAF on the basis of the fishery act 41/82and covered four fishing seasons from 1993-94 to 1996-97, while the third one was financed by the Regional Government and carried out in the most recent fishing season (2009-10) (see chapter 1.2).

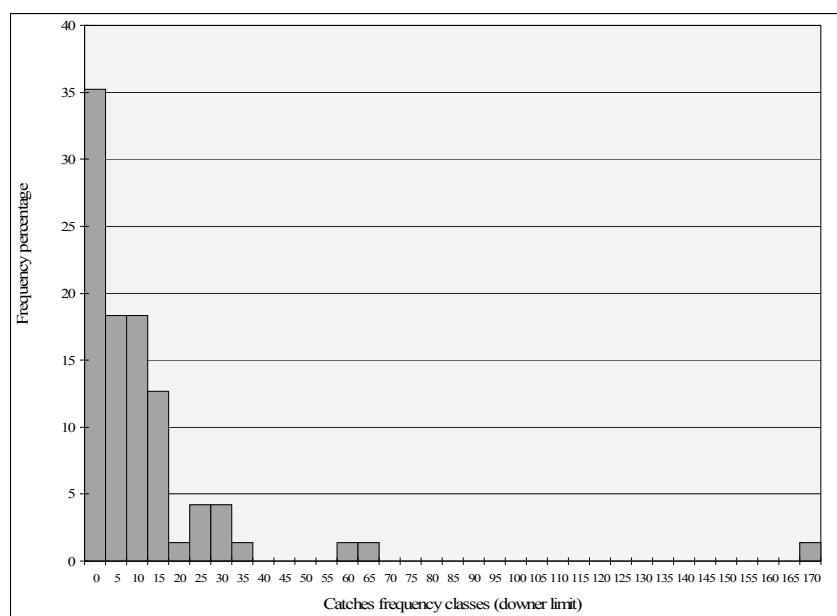



Figure 37 - Statistical distribution of transparent goby catches in the Ligurian area (n = 71)

During these projects a sum of 71 daily catch data were gathered and are reported in table 23. In table 24 are shown the main statistical descriptors of this data series. As reported for Tuscany, also the Ligurian data are characterized by high kurtosis (31.48) and asymmetry (5.00) values, indicating that the data have a lognormal distribution (fig. 37).

Table 23 – Ligurian data series from 1993-94 to 2009-2010 fishing seasons. (Number of observations from 1 to 35 are recorded on board of professional fishing vessels)

N° of observations	Date	Harbour	Daily total weigth (kg)	N° of observations	Date	Harbour	Daily total weigth (kg)
1	09/12/1993	Camogli	11.5	37	03/12/2009	Sanremo	2.0
2	04/01/1994	Camogli	4.8	38	09/12/2009	Sanremo	2.0
3	12/01/1994	Camogli	4.9	39	09/12/2009	Sestri Levante	35.0
4	25/01/1994	Sestri Levante	3.3	40	09/12/2009	Sestri Levante	3.0
5	01/02/1994	Sestri Levante	6.5	41	11/12/2009	Sanremo	2.0
6	09/02/1994	Camogli	2.1	42	12/12/2009	Sanremo	2.0
7	18/02/1194	Camogli	13.8	43	14/12/2009	Sanremo	2.0
8	02/03/1994	Camogli	3.1	44	15/12/2009	Sanremo	2.0
9	11/03/1994	Camogli	5.5	45	16/12/2009	Sestri Levante	15.0
10	13/02/1995	Camogli	5.0	46	16/12/2009	Sestri Levante	38.0
11	21/02/1995	Camogli	13.4	47	16/12/2009	Sanremo	1.0
12	20/11/1995	Sanremo	1.1	48	17/12/2009	Sestri Levante	20.0
13	04/12/1995	Sanremo	2.2	49	18/12/2009	Sestri Levante	5.5
14	18/12/1995	Sanremo	2.4	50	19/12/2009	Sestri Levante	35.0
15	20/01/1996	Sanremo	15.0	51	09/01/2010	Sestri Levante	18.0
16	31/01/1996	Sestri Levante	4.6	52	15/01/2010	Sestri Levante	8.5
17	10/02/1996	Sanremo	5.1	53	16/01/2010	Sestri Levante	11.0
18	12/02/1996	Camogli	1.8	54	18/01/2010	Sestri Levante	18.0
19	09/03/1996	Camogli	2.3	55	18/01/2010	Sestri Levante	30.0
20	25/11/1996	Sanremo	7.3	56	18/01/2010	Sanremo	4.0
21	02/12/1996	Sanremo	16.2	57	19/01/2010	Sestri Levante	28.0
22	04/12/1996	Camogli	69.2	58	19/01/2010	Sanremo	15.0
23	04/12/1996	Camogli	20.0	59	20/01/2010	Sanremo	15.0
24	12/12/1996	Sanremo	10.0	60	20/01/2010	Sestri Levante	65.0
25	16/12/1996	Sanremo	7.2	61	21/01/2010	Sestri Levante	31.0
26	23/12/1996	Sanremo	20.0	62	21/01/2010	Sanremo	15.0
27	31/12/1996	Sanremo	10.5	63	22/01/2010	Sanremo	15.0
28	03/01/1997	Camogli	15.4	64	22/01/2010	Sestri Levante	23.0
29	10/01/1997	Camogli	16.4	65	28/01/2010	Sestri Levante	7.8
30	11/01/1997	Sanremo	11.0	66	28/01/2010	Sanremo	15.0
31	16/01/1997	Sestri Levante	171.7	67	01/02/2010	Sestri Levante	30.0
32	17/01/1997	Sanremo	6.0	68	02/02/2010	Sestri Levante	18.0
33	25/01/1997	Sanremo	2.8	69	01/02/2010	Sanremo	7.0
34	30/01/1997	Ventimiglia	4.0	70	02/02/2010	Sanremo	8.5
35	26/11/2009	Sanremo	5.0	71	16/02/2010	Sestri Levante	9.0
36	02/12/2009	Sanremo	2.0				

Table 24 - Main statistical descriptors of Ligurian data series:

Statistical descriptors	
Mean	14.92
Standard error	2.73
Median	8.50
Standard deviation	22.98
Kurtosis	31.48
Asymmetry	5.00
Minimum	1.00
Maximum	171.68
First quartile	**3.65**

The catch data were verified in a sample of inspections performed under the programme of statistical data collection and biological sampling of catches as per Reg. (EC) 1543/2000, Reg. (CE) 1639/2001, Reg. (EC) 1581/2004 and basically agree with the findings in the archives of the Harbour Offices or fishing cooperatives.
To verify the reliability of such data an analytical technique was applied based on Benford's law (Benford, 1938 and Newcomb, 1881), that is usually used for audits, checking economic data sets and verification of company financial statements (Nigrini, 2000, Sehity *et al.* 2005; Cho & Gaines, 2007), accepted as legal evidence in U.S. courts (Nigrini, 2009) and was also used to verify the recent Iranian elections (Battersby, 2009).
This is one of the numerical techniques (e.g. Stein & Meyer zu Eissen, 2005) that allow for an analysis of some intrinsic features of large series of numerical values to highlight, based on probability, their agreement with certain laws or hypotheses.
The frequency analysis of the first amount of the 18,000 transparent goby catch data indicates, as required by Benford's law, a value decreasing from over 30% to values around 5%, while the later ones are arranged around the expected value of 10%. This feature, which is difficult to reproduce artificially (and, furthermore, coordinated between around fifty subjects) supports the assessment of data reliability.

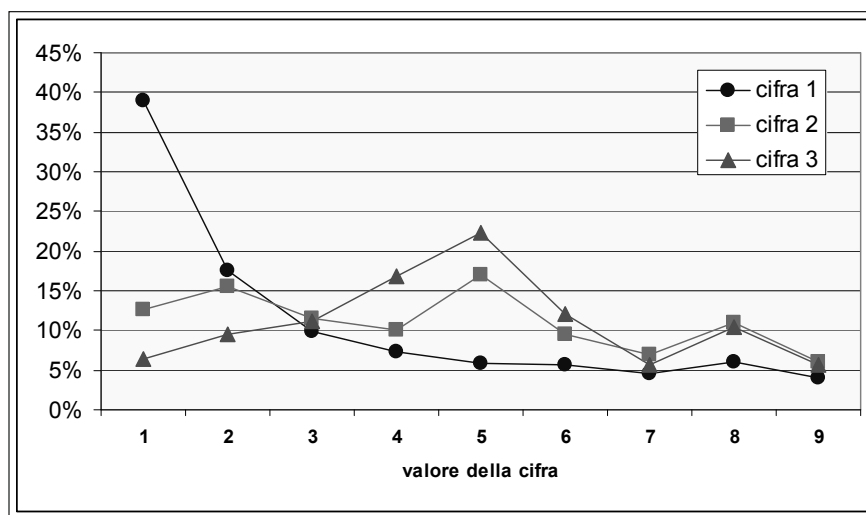



Figure 38 - Application of Benford's law to the daily transparent goby catches

It is also significant to note that the frequency of the value 5 in the second and third amounts, around 20%, is twice the expected frequency and indicates a rounding trend with the amount 5 (i.e. 15 kg are used more often than 14 kg or 16 kg). Conducting the analysis by splitting the time series into three segments of six years each (about 6000 values) leads to similar results and suggests that the use of rounding has been accentuated in recent years, but only for catch values exceeding 100 kg/day/boat.

In conclusion, briefly, the set of catch data 1991-2009, derived from survey forms, is deemed to be reliable based on the following considerations:

- The tests performed in the statistical programs are positive;
- The number of days of annual fishing has remained fairly constant for 20 years;
- The annual catches, however, vary greatly based on fluctuations of the resource and no trend has been detected;
- The values of daily catch per boat are distributed as expected in a lognormal mode;
- The values comply with Benford's law;
- The fishing of Tuscan transparent goby is mostly directed outside the region, and therefore

subject to restrictions and controls relating to large-scale transportation and marketing;

- The daily catches per boat in Tuscany are well above those recorded in other Mediterranean areas (e.g. Liguria and the Balearic islands).

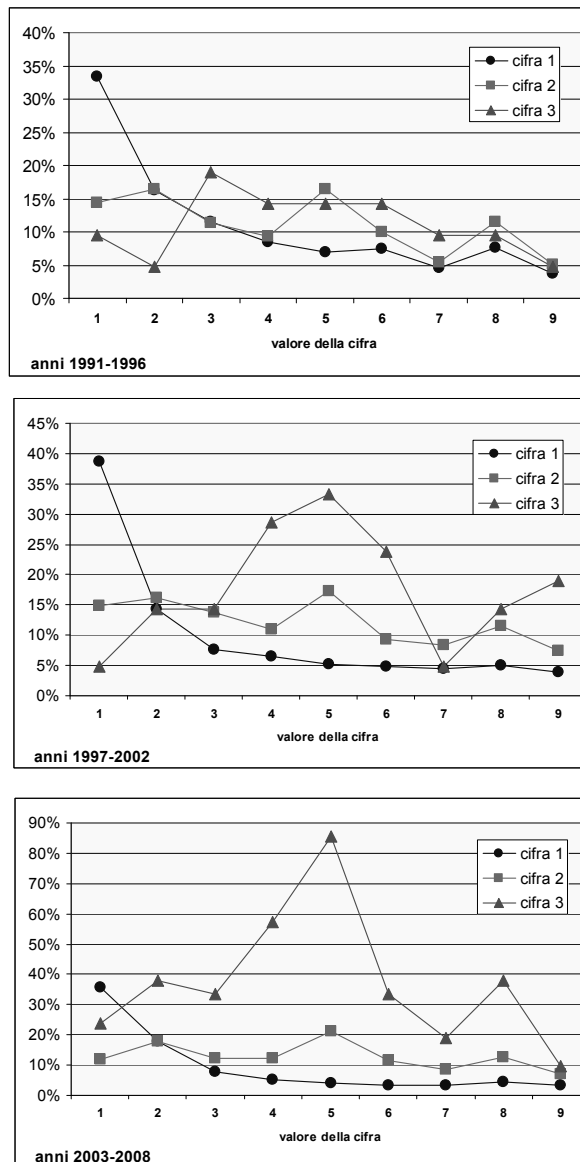
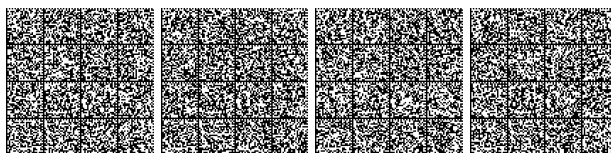



Figure 39 Application of Benford's law in three time segments

4.3 Spatial distribution of the resource

Information for carrying out this analysis was available for the Tuscan fishing areas alone.
Looking in more detail at the distribution of resources during the nearly 20 years of survey, cases are identified, as for 2001 and 2002, in which the resource appears to be evenly distributed among the various areas of Tuscany considered (standard deviation = 1.4).
On the other hand the resource is more concentrated in other years; for example in 1997 the area which records a greater concentration is that of Porto S. Stefano (standard deviation = 9.9) while in 2007 the

highest concentrations are found mainly in the area of Livorno (standard deviation = 10.6).
The year 1998 is rather sort of a borderline case because the resource is very concentrated in the area of Porto S. Stefano with a catch of up to 489 kg/day/boat (Standard deviation = 13.7).

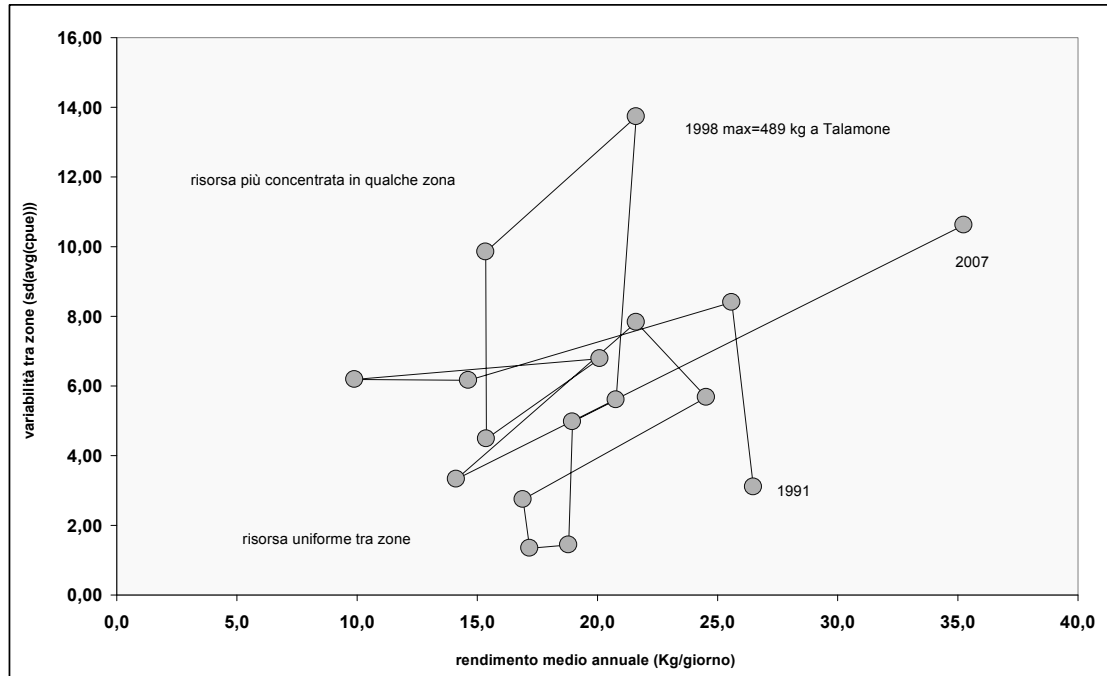



Figure 40 - annual CPUE and variability between the fishing areas

The wide variability observed, both with time and in the geographical location of the transparent goby leads us to consider the stock as basically stable, albeit with marked dynamics and probably explicable by meteorological and oceanographic factors, whose nature is not currently defined.

4.4 Relationship between catches and fleet characteristics

A comparison of the average daily catches and structural characteristics of the fleet indicates that the yield of fisheries is significantly correlated ($r^2 = 0.76$) to tonnage, while there was no correlation ($r^2 = 0.08$) with the power of the vessel.

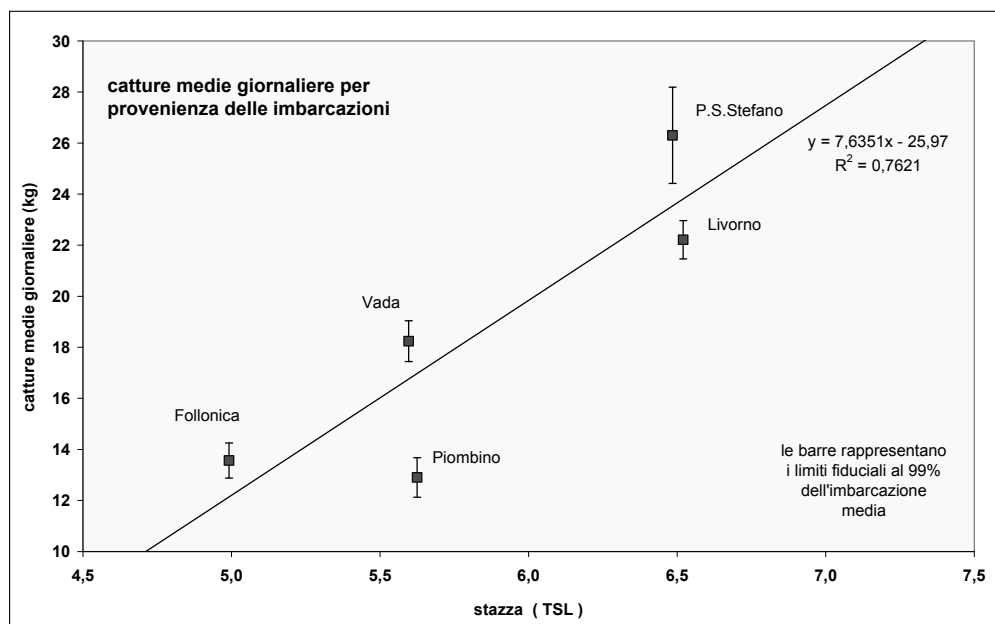



Figure 41 - Correlation between the structural characteristics of the fleet (tonnage) and average CPUE

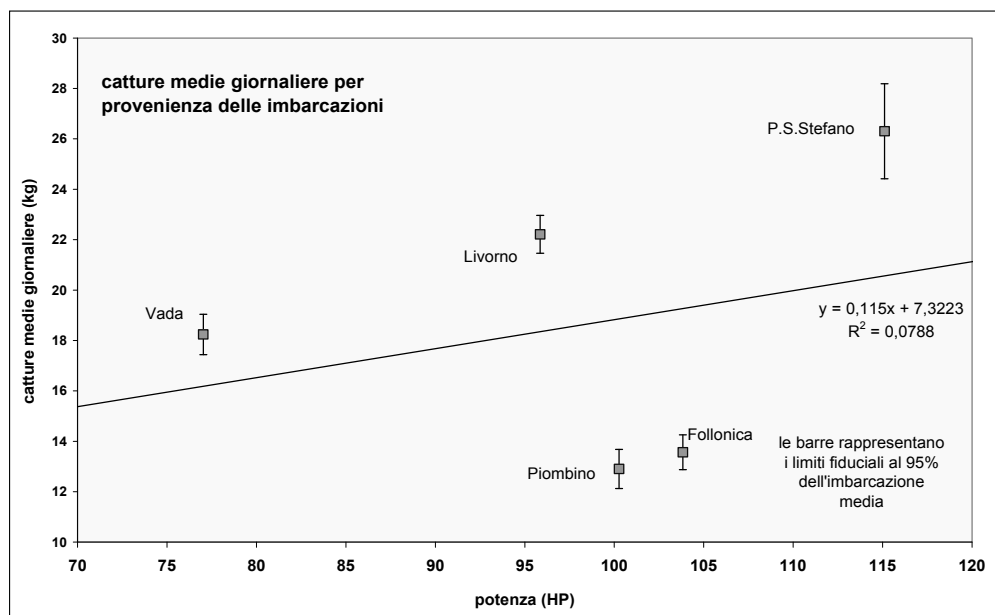



Figure 42 - Correlation between the structural characteristics of the fleet (power) and average CPUE

4.5 Assessment of exploitation status

There are at the moment no reference points defined by the rate of fishing mortality F for the species *Aphia minuta* and there is also no knowledge of the relationship between spawning stock and recruitment. Therefore, the proposed management measures will have to come from assessments derived from trends in the biomass or catches. Anyway, from what has been previously described, biomass appears to show some stability and it is possible that the success of recruitment is more associated with environmental factors than to variations in the size of the spawning stock.
The catch for the last 20 years in Tuscany and for the last 14 years in Liguria has shown strong fluctuations, which could only partly be attributed to fluctuations in recruitment. It has in fact been seen over the years that the period of recruitment is early or late compared to the legal fishing season which is instead the same for all years. The amount of the catches varies depending on when peak recruitment occurs every year and how this then coincides with the fishing season. In conclusion, the catches may be lower or higher without this indicating a real change of biomass in the sea.
To assess and monitor the fisheries, it is therefore necessary to define a minimum level of biomass or average value that serves as a reference point, above which the biological sustainability of the stock can be safely guaranteed.
Whereas it is technically very difficult to quantify recruitment before the fishing season, a practical and measurable way to manage fisheries is to control fishing effort. This effort, during 20 years of investigation that have yielded data, has remained almost unchanged, and has proved sustainable based upon catch trends in the same period.
Control of the effort may become useful if the catching of the resource remains almost unchanged over the years, and if we assume that each unit of effort will produce an equal fraction of fishing mortality.
Evaluating the consequences of any increase in fishing pressure on the species is not possible at this time and consequently, as a precautionary approach, the authorization of new fishing vessels or increasing the length of the fishing season are not recommended.
The threshold value may be defined as a biomass index (expressed as catch/day/boat), wherein, by use of the overall catch, a significant decline in annual catches may be seen without implying any reduction of biomass in the sea.
In Tuscany, a value of 17 kg/day, representing the lowest quartile for the last 20 years of fishing is considered appropriate as a lower limit for the biomass index.
In the Ligurian area, as above explain, a consistent time series of CPUE data is not available and for this reason, the Ligurian Government has set up a triennial monitoring plan, beginning during the fishing season 2009-2010. Together with data obtained from this project, which included sampling at landing and observations on board, a CPUE (kg/boat/day) data is available from research programs carried out in the nineties and funded by MiPAAF (see chapter 1.2).The main statistical descriptors of this available data set have been shown in table 24. The median figure appears to be a realistic datum, supporting the assumption that yields not exceeding 10 kg/boat/day represent an acceptable economic return for fishermen. In fact, as reported above, the transparent goby can be sold at very high prizes, a fact compensating for the small fished quantities. So, in analogy with the method suggested for the Tuscany area, we propose that the first quartile value of the above mentioned data series (i.e. 3.65 kg/boat/day) should be considered as a limit biomass reference point for the Ligurian area

Table 24 - Model of catch form used for daily transparent goby catches

TRANSPARENT GOBY FISHING (Aphia minuta)

Compliance with the Ministerial Decrees of 20 Dec. 1985 and of 11 Nov. 1990 (and subsequent amendments)

Maritime District			
Owner			
Ship name		Registration No.	
HP	KW	GT	Net used m
Year		Month	

Fishing day	Fishing site	Kg caught transparent goby	Other catches	Kg caught other species

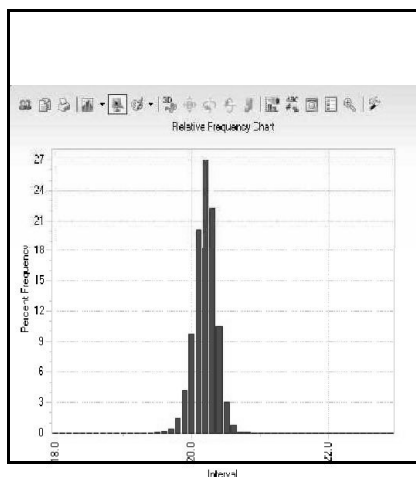
4.6 Management plan Monitoring

Boats licensed to use seines for transparent goby fishing are required to fill out forms recording daily catches and deliver them to institutional authorities. The forms contain the date, daily catch of transparent goby, fishing area and any other catches.

Samples of transparent goby will be collected periodically to improve biological information of the species, growth, natural mortality, condition, feeding and population size. This information, combined with oceanographic data, can produce more extensive evaluations of the status of the resource and allow predictions to be made for future generations to help with the process of managing fisheries. In the future, the oceanographic modelling can provide both a better basis for stock assessment, and assist in the spatial management of exploitation of the resource.
Special attention should be devoted to the study of early life stages of the species and its relationship with environmental factors, these factors may be decisive for the purposes of recruitment.
Pending a more detailed assessment based on better knowledge of the biology of the species, the impact of environmental conditions on recruitment, growth, etc.., there will be monitoring of the exploitation status and fishing activity based on the indicators presented below.

Monitoring will be performed through the choice of biological indicators used for assessing the status of exploitation and biological sustainability, in particular, catch data and the biomass index represented by the daily catches per boat. The value obtained for the last fishing season is compared to the reference limit value derived from analysis of the biomass trend from available historical data.

The reference value is represented by that value of biomass (in this case its index) that proves sustainable over time. Due to the uncertainty of this reference value estimate, two alternative approaches have been explored.
The Depletion Corrected Average Catch Model (DCAC) (MacLean, 2008) permits an estimate of the level of yield or catch that is assumed to be sustainable. The objective is to identify a relatively high and sustainable yield with low probability that this capture is close to the value of the maximum sustainable catch (Maximum Sustainable Yield, MSY) and consequently can prevent overfishing and possible collapse of the resource.
A proof based on evidence for sustainable yield is represented by the observation of prolonged periods during which the catches were made over the years with no apparent indication of a reduction of abundance in the sea. This long-term sampling may be estimated as the average catch for the period analyzed, which did not show any trend. If the resource decreases, it means that a fraction of the total catch is no longer supported by a catch potential with sustainable yield.
The approach based on these concepts is a simple method for estimating sustainable yields in situations of scarcity of data, even if it is necessary that a series of historical catch data is available. Although the method is relatively new and there is limited use experience,testing with real data and simulations suggest that this approach is solid.

Application of the DCAC method was designed for transparent goby assuming a natural mortality M = 3.0, and biomass, both at the beginning and end of the historical series analyzed, close to virgin biomass, with a variation (delta) of ((B last year - B first year)/B virgin) = 0.12.
Whereas it is not possible to estimate the absolute value of biomass per year, the analysis was done using the daily catch per boat as a biomass index. A value of this index amounting to 20.4 kg /day/boat was obtained as output from the model.

Probability distribution of the estimate

Depletion Corrected Average Catch Model Version 1.1.1
(Calculation)
Case Description:
transparent goby

Number of Years = 18
Random Number Seed = 24218750
Number of
Iterations = 10000

	Value	STD Deviation
Sum of Catch =	367.5619	
Natural Mortality =	3.0000	0.0000
FMSY to M =	1.0000	0.2000
Depletion Delta =	0.1200	0.1000

Uncorrected Avg Catch
= 20.420107
Average
DCAC = 20.302232
Median DCAC = 20.307604
1% - 99% CI = 20.020650 - 20.536970
5% - 95% CI = 20.123841 - 20.461735
10% - 90% CI = 20.170120 - 20.427537
20% - 80% CI = 20.221622 - 20.386099

Minimum = 19.464417 - Maximum = 20.708054

Figure 38 - Application results of the DCAC model

A second method tested for estimating a value limit on the biomass (Reference Point) is the choice of the 25th percentile (lower quartile) of the transparent goby catch index for the last 18 years (1991 to 2009).

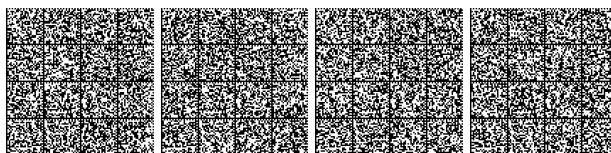
The lowest quartile was chosen assuming that the biomass for all these years has always been around its maximum at the beginning of the season, with random variations due to the success of recruitment and including a statistical noise due to interannual variations about the possible time shift of peak recruitment which may affect the average yields.

The lower quartile value is considered a precautionary value, below which it is considered that the biomass of individuals who survive to adulthood is not sufficient to ensure self-renewal of the population. Values lower than the quartile occurred in fewer than 25% of the years. The percentile value estimated by this approach was equal to 17 and 3,65 kg/day/boat per fishing season, respectively for Tuscany and Liguria Regions.

Both methods suggest quite similar values but, as the second method requires fewer assumptions it is chosen as the most valid.

It is therefore proposed that if the annual average catch per day and boat index is below the reference value of 17 and 3,65 kg/day/boat, respectively for Tuscany and Liguria, for 3 consecutive years, corrective management action be required. In such a case one of the following limitations should be adopted:

a) reduction of the fishing season by means of a month-long halt on fishing

b) reduction by one day of the fishing days in a week.

If the indicator does not return to over 17 and 3,65 kg/day/boat in the next two years, there will be a halt to fishing for an entire year.

In order to assess the economic and social sustainability of the goby fishery in GSA 9 specific indicators will be drawn and calculated aiming to measure fleet results overtime.

The indicators will be used to evaluate the economic and social impact emerging from the Goby management plan and will concern:

- Income variation of fishermen involved by the management plan,
- Profitability variation of the small enterprises involved by the management plan,
- Impact of the management plan on employment
- Improvement of competition conditions emerging from the implementation of the management plan

Socio economic indicators have been chosen from those quoted in literature as far as they are coherently able to assess the performance characterized by a high artisanal level, low level of investment, owner participating in the fishing activity.

Economic indicators and description

Indicator	**Description**
Gross profit/vessel	Average profit by vessel
Added value/employee	Added value per employee

Social indicators and description

Indicator	**Description**
Gross sales by single member of the crew *	Value of production per employee.
Total emplyed in the specific fishery (num)	Total number of employees
Average wage (000 €) **	Average wage per employee in the fishing sector.

* Deflated by general consumer price index
** Deflated by employees and workers price index .

Each indicator’s calculated values will be checked against their reference points (RP) by using a “traffic light” approach. The “traffic light” approach allows a synthetic graphic format easily readable and ready to be interpreted allowing an immediate interpretation of the fishery following an ecosystemic and sustainability approach. The indicators will be presented by a colour key which

is reported in the following. Colours are attributed by comparing the calculated value of each indicator and its reference point (RP).

legenda	Indicators trend	Reference Point
	Positive	Current value >RP
	Stable	Current value next to RP
	Negative	Current value < RP
	not available	

Through the “traffic light approach, economic and social indicators shall allow to detect the existence of equilibrium between fishing capacity and fishing possibilities, which itself depend on the overall state of the stock.

CHAPTER 5 - MANAGEMENT MEASURES

5.1 Control of fishing effort

Access to the transparent goby fisheries will only be allowed to authorized vessels, using boat seines.
Vessels licensed to use seines for transparent goby fishing are required to fill out forms recording daily catches and deliver them to institutional authorities. The forms contain the date, daily catch of transparent goby, fishing area and any other catches.

5.1.1 Fishing capacity:

a) ***restrictions on the fleet***: vessels using boat seines for the fishing of the species *A. minuta* in GSA 9 ports shall not exceed, for any reason, 142 units total, 48 and 94 boats in Tuscany and Liguria respectively and shall have a track record in the fishery of more than five years. According to Article 19, comma 6 of the second paragraph of Reg. (EC) No. 1967/2006, these vessels will be issued a fishing authorisation, irrespective of vessel's dimension and fishing capacity. Such authorisation shall indicate the fishing gear, the specified period, the maximum number of fishing days, the single target species (transparent goby; Aphia minuta); no other species shall be included in this single fishing authorization. Each vessel can only operate in the maritime department of registration ;
b) ***single net***: when fishing for the transparent goby it is prohibited to use and retain on board other fishing gears than the authorized boat seine.
c) ***restrictions on fishing capacity***: the vessels authorized to fish the species *A. minuta* with seines are exclusively those vessels with individual tonnage not exceeding 15 GT and 120 KW.

5.1.2 Fishing activity

a) ***limitation of the fishing season:*** the use of boat seines for fishing of the species *A. minuta* is only allowed for no more than 60 days during the period between November 1 and March 31 of each year, unless the fishing season has been reduced on the basis of the management measures referred to in this decree.
b) ***limitation of time at sea***: fishing activity is only allowed from one hour after sunrise to sunset. Fishing at night and the use of light sources are forbidden.

5.2 Technical measures

Some technical measures are adopted to contribute to maintaining fishery sustainable. In particular:

a) ***limitation on the size of fishing gear***: net length should not exceed 300 m and should be armed with neutral buoyancy in order to avoid impact on the seabed;
b) ***limitation of the mesh size***: the mesh will be in the range from 3 to 5 mm;
c) ***limitations of fishing areas***: Vessels are allowed to fish within the Compartiment area where the authorization has been issued and within a range of 3 miles from the coast;
d) ***protected habitats:*** fishing above seagrass beds of, in particular, Posidonia oceanic, shall be prohibited;
e) ***restrictions on by-catches and incidental species***: the incidental daily catch of juveniles of

other species should be a fraction less than 2% by weight and any specimens caught must be released unharmed and alive. Accessory catches, except pelagic gobies, shall not exceed exceed 10% by weight of the total daily catch and shall be registered in the logbook and reported to the scientific body in charge of monitoring.

f) **Prohibition to catch whitebait (bianchetto) and Mediterranean sandeel (cicerello):** catches and landings of whitebait (bianchetto) and Mediterranean sandeel (cicerello) shall be prohibited and any accidental by-catch shall not be retained on board and cannot be landed, unless the European Commission decides otherwise in line with the procedure provided in article 13 (5) of Regulation 8EC) N. 1967/2006.

5.3 Monitoring catches and effort

A scientific body will be appointed in each Region and will be responsible for monitoring and reporting on the activity and catches of the fleets. The scientific bodies will use identical procedures and methodologies.

The stock status and fishery performance is monitored through a set of data sources. In particular:

a) collection of samples***:*** regular fishery samples of transparent goby and other species caught will be pursued according to a statistical sample targeting various biological information (demographic structure, gender, feeding, maturity, condition, etc...). Based on the monitoring results a yearly report on growth rates, mortality, recruitment periods and spatial distribution by size, models of exploitation status assessment will be produced by each scientific body. In this way more detailed management guide lines can be provided in future years. Provision of catch samples is obligatory.

b) researchers embarking on board: according to the sample design researchers will be embarked onboard to permit direct observation of fishing operations and gear characteristics, as well as to monitor catches and by-catches.

c) catch and effort forms: without prejudice to regulation (EC) N. 1224/2009 of 20 November 2009, and notwithstanding the provisions of Article 14 therein, also the fishing vessels of less than 10 metres length overall authorized for transparent goby fishing shall keep a logbook of their fishing operations indicating specifically all quantities of each species caught and kept on board, even for live weight equivalent below 50 Kg. Each vessel will fill in the logbook, on a daily base. Logbook shall be returned to the port authority within 24 hours from the return to the port. The scientific body will be in charge to collect the logbook from the port authority. Daily catch, date, fishing area, time spent at sea, any by-catches, will be reported in the logbook. The scientific bodies will be responsible for gathering logbooks and storing information in a database for subsequent analysis. The database will be identical in each region.

The monitoring plane shall ensure:

- recording and validation of catching and landing statistics;
- recording and validation of species/size composition;
- recording of gear characteristics;
- quasi real-time estimate of the reference point to implement the pre-negotiated management measures;
- estimate of alternative references points adequate to develop an in-year management approach to boat seines fishing for transparent goby;
- collection of environmental data to possibly develop a predictive model for the recruitment strength.

5.4 The pre-negotiated management measures

Limit reference point

For the maritime Directorate (zone) of Livorno the limit reference point of the lowest quartile of the time series of the annual average catch per unit of effort (CPUE) shall be 17,00 Kg/day/boat.

For the maritime Directorate (zone) of Genova the limit reference point of the lowest quartile of the time series of the annual average catch per unit of effort (CPUE) shall be 3,65 Kg/day/boat.

Early closure of the fishing season

In case that the annual average CPUE falls below the limits referred to above in the first or second fishing season authorised, in the second or third fishing season, respectively, the average CPUE shall be computed by 1 February and if it remains below the limits the fishing season shall be closed by the end of February of that year.

Corrective management measures

In case that the annual average CPUE falls below the limits referred to above for two consecutive fishing seasons corrective management measures, such as reduction of the next season or closure, shall be adopted before the starting of the subsequent fishing season, if any.

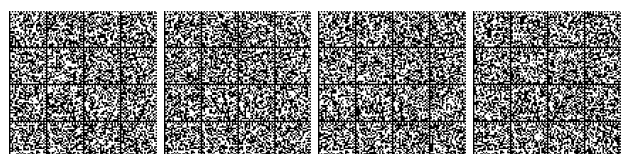
Suspension of the fishing for transparent goby

In the event that the annual average CPUE does not rise above the limits referred to above in the three years period during which the derogation is authorised, then fishing for transparent goby shall be stopped for at least an entire fishing season in case a subsequent derogation is granted by the European Commission for a new period.

5.5 Duration of the derogation

The measures will be implemented from the date of approval, for an initial period of three years, with annual monitoring and evaluation of resources and implementation of any emerging limitations set out in this plan. Extension beyond this period will be subject to European Commission decision on the basis of updated reporting and draft management plan to be submitted by Italy in due time.

5.6 Fishery management system governance – the surveillance and control strategy

The above described *Aphia minuta* Management Plan needs a governance system, based on surveillance and control strategies. On the basis of the results of the scientific and economic monitoring activities, governance must assess whether the management measures are appropriate and, if not, introduce corrective elements taking into account the management indications and the pre-negotiated management measures.

The governance must provide for:

Surveillance system: an appropriate surveillance system able to detect the state of the target stock and to ensure the balance of the exploitation level with the good health of the stock of target species, within safe biological limits.
In order to implement surveillance, a "Management Body" (OdG), will be established. It will be a collegial body, including representatives of the Regions, fishermen, fishermen associations and scientific research.
Inside, the OdG should provide a reference person responsible of the scientific aspects and evaluation of the resource, and a socio-economic representative, responsible for the collection and processing of socio-economic indicators.
Each year, having in mind the timing referred to in point 5.4, the OdG collects the results about the previous and/or ongoing fishing season provided by the coordinator of the research and the socio-economic reference and proposes the renewal of the Plan or, if deemed necessary, prepare a new “management proposal” for the following year.

Control system: an appropriate Control System able to ensure compliance with the management measures provided in the plan. Currently identified in the Maritime Directorate of Liguria – Coastal Guard; acts as the control on compliance with the rules established in the Plan, in particular through the issuing of licences and through controls on fishing activities at sea.

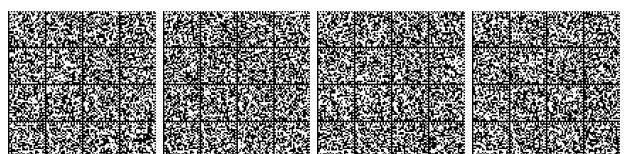
6. RICHIESTE DI DEROGHE PER LA PESCA CON SCIABICA ENTRO LE TRE MIGLIA (ART.13 PAR.5) E PER LA DIMENSIONE MINIMA DELLE MAGLIE (ART. 9 PAR. 7) PER LA PESCA DEL ROSSETTO NEI COMPARTIMENTI DELLA LIGURIA E DELLA TOSCANA

From the previous analysis it clearly emerges that, both for Ligurian and Tuscany fishing areas, the minimum distances and depths for the use of boat seines need a derogation to article 13 paragraph 1 of the Council Regulation (EC) N. 1967/2006. This request is justified by the fulfilment of criteria listed in article 13, paragraph 5 of the same Council Regulation. In particular:

a) The coastal platform is of limited size, especially in the Ligurian Sea, and this fishing technique can be exerted only within a small distance (10-100 meters) from the coast where the goby concentrates in wintertime.
b) The fisheries have no significant impact on the marine environment since only on clean grounds the net can work and also the bycatches are insignificant as shown in chapter 3.5 of this Plan.
c) The vessels allowed to this fishing technique are limited with respect to the number of those that have been fishing over last 20 years, and with fairly stable CPUE as shown in chapter 4.1 of this Plan.
d) This singlespecies/singlegear fishery cannot be undertaken by using an alternative gear since the boat seine is the only one that allows the catch of transparent goby.
e) A list of authorised fishing vessels and their characteristics is here enclosed in chapter 3.5 of this Plan

f) The vessels included in the list reported in chapter 3.5 have been already authorised by the Member State for more than five years with a track record in the fishery and will not involve any future increase in fishing effort.
g) This fishing targeting the transparent goby has no interferences with the activities of vessels using other fishing gears as trawls, seines or any other net.
h) The fishery is regulated, as shown in chapter 5.3 of this Plan, in order to ensure that catches of species mentioned in Annex III are minimal and it does not target cephalopods.
i) From what above said, a derogation is therefore required, to art. 13 and 9 of the Reg. (CE) 1967/2006 as follows:

6.1 Richiesta di deroga per la pesca con sciabica boat seines del rossetto entro le tre miglia (art.13 par.5)

In derogation to Article 13 of Reg. (EC) No 1967/2006 on minimum distance from the coast for towed gears, a specific authorization is requested from the Commission for fishing within three miles, as conditions pursuant to Art. 13 par. 5 and 9 are present.

The derogation shall be applied exclusively to vessels which possess a regular fishing permit issued for fishing rossetto using boat seines, according to the procedures determined by the Management Plan adopted by the National Administration, and pursuant to Art. 19 of Reg EC No 1967/2006, stated in the following section.

Vessels involved in this particular type of fishing represent, compared to the overall fleet, a minor share of fishing capacity (less than 1% of the total GT), hence, it is a fishery which concerns an extremely small number of vessels.

The selectivity of the fishing gear, the single-species catch, the low level of by-catch and the low fishing effort which distinguish this type of fishing are elements from which it can be concluded that the impact on the marine environment is to be considered insignificant.

6.2 Derogation granting in relation to the minimum mesh size (Art. 9 par. 7)

In derogation to Art. 9 of Reg EC No 1967/2006 the use of mesh less than 40 mm minimum size for fisheries pursuant to the rossetto fishing Management Plan using boat seines, adopted by the National Administration, in accordance with Art. 19 of Reg. EC No 1967/2006. The derogation is granted exclusively for those vessels that already possess a regular fishing permit for these fisheries.

Art. 4 par. 5 provisions of Reg EC No 1967/2006 do not concern the type of fishing object of this Management Plan.

BIBLIOGRAFIA CITATA

Abella A., Auteri R., Baino R., Lazzaretti A., Righini P., Serena F., Silvestri R., Voliani A., Zucchi A. 1997. Reclutamento di forme giovanili nella fascia costiera toscana. *Biol. Mar Medit*., **4**(1): 172-181.

Auteri R., Abella A., Baino R., Donati L., Lazzeretti A., Righini P., Serena F., Silvestri R. 1996. Studio per l'individuazione di un sistema razionale per lo sfruttamento del rossetto nell'Alto Tirreno. Rapporto Ministeriale, 51 pp.

Auteri R., Abella A., Baino R., Righini P., Serena F., Silvestri R., Voliani A. 1998. La pesca del rossetto (*Aphia minuta*, Pisces, Gobidae) in Toscana. *Biol. Mar. Medit*., **5** (3): 477-486.

Auteri R., Froglia C., Relini G. 2000. Pesca del "rossetto" *Aphia minuta* De Buen 1931 (stagioni 1995-1996 e 1996-1997) nei compartimenti marittimi di Imperia, Savona, Genova, La Spezia, Viareggio, Livorno e Pescara. *Biol. Mar Medit*., **7**(4): 99-105.

Baino R, Auteri ., Donati L. 1995. Crescita e reclutamento alla pesca del rossetto. Atti XXVI Congr. SIBM.

Baino R., Aueri R., Donati L. 1996. Crescita e reclutamento alla pesca del rossetto. *Biol. Mar Medit*., **3**(1): 525-526.

Battersby S., 2009. Statistics hint at fraud in Iranian election. New Scientist n.2714, 24.06.2009.

Benford, F., 1938. The Law of Anomalous Numbers. Proc. Amer. Phil. Soc. 78, 551-572..

Biagi F., Gambaccini S., Zazzetta M. 1997. Insediamento e microhabitat di specie ittiche nella fascia costiera toscana. *Biol. Mar Medit*., **4**(1): 195-203.

Brunet-Quetglas, M. (2004) Estudio de selectividad del "jonquiller" como arte menor de pesca en Baleares. Dirección General de Pesca, Conselleria d' Agricultura i Pesca, Govern de les Iles Baleares.

Caputo, V., Candi, G., Arneri, E., La Mesa, M., Cinti, C., Provinciali, M., Nisi Cerioni, P., Gregorini, A. (2002) "Short lifespan and apoptosis in *Aphia minuta* " J. Fish Biol. 60: 775-779

Chesalin, M.N., Zuev, G.V., Chesalina, T.L. (2004) "Transparent goby *Aphia minuta* (Gobiidae) in the pelagic zone of the Black Sea" J. Ichthyol. 44: 587-591

Cho W. and Gaines B., 2007. Breaking the Benford Law: statistical fraud detection in campaign finance. The American Statistician 61 (3): 218–223.

Fisher W., Bauchot M.L., Schneider M. 1987. Fisches FAO d'identification des especes pou les besoins de la peche. (Revision 1). Mediterranee et Mer Noire. Zone de peche 37. 2. Rome. FAO: 761-1530.

Froese R., Pauly D. (eds), 2009. Fishbase World Wide Web electronic publication. www.fishbase.org. Version may 2009.

Froglia C., Gramitto M.E. 1989. La pesca del rossetto (*Aphia minuta*) nel medio Adriatico. *Nova Thalassia*, **10** (suppl. 1): 447-455.

Froglia C., La Mesa M., Arneri E., Gramitto M.E. 1998. La pesca del rossetto nel compartimento marittimo di Pescara (Medio Adriatico). *Biol. Mar Medit*.,5(3): 503-512.

Giovannotti M., La Mesa M., Caputo V. (2009) Life style and genetic variation in teleosts: the case of pelagic (Aphia minuta) and benthic (Gobius niger) gobies (Perciformes: Gobiidae). Marine Biology, vol.156: 239-252.

IGLESIAS, M., MORALES-NIN B. (2001) - Life cycle of the pelagic goby Aphia minuta (Pisces: Gobiidae). *Sci. Mar*. **65**(3):183-192.

La Mesa M., Borme D., Tirelli V., Di Poi E., Legovini S., Fonda Umani S.(2008) Feeding ecology of the transparent goby Aphia minuta (Pisces, Gobiidae) in the northwestern Adriatic Sea, Scientia Marina, Vol 72, (1): 99-108.

Lo Bianco S. 1909. Notizie biologiche riguardanti specialmente il periodo di maturità sessuale degli animali del Golfo di Napoli. *Mitt. Zool. Stat. Neapel*, **19** Bd 4 Heft.

MacCall A. 2008. Age Structured Assessment Program, Version 2.0.11. /NOAA Fisheries Toolbox,: http://nft.nefsc.noaa.gov .

Martinez-Bano P., Vizuete F., Mas J. Y., Faraco F., 1990. Biology and fishing of *Aphia minuta* (Risso, 1810) in the S.E. of the Iberian Peninsula. *Rapp. Comm. Int. Medit*., **32**(1):256.

Mennella M. 2009 - ROSSETTO (Aphia minuta) metodo di cattura: sciabichello toscano. Valore economico. Coop. S. Maria Assunta (mimeo) 8pp.

Newcomb, S., 1881 - Note on the Frequency of the Use of Digits in Natural Numbers. Amer. J. Math. **4**, 39-40.

Nigrini M. 2009 - From Benford to Erdös. WNYC Radio Lab. 2009-09-30. No. 2009-10-09.

Nigrini M., 2000 - Digital Analysis Using Benford's Law: Tests Statistics for Auditors. Vancouver, Canada: Global Audit Publications, 278 pag.

Pauly D. 1984. Fish Population Dynamics in Tropical Waters. A manual for use with programmable calculators. ICLARM Stud. Rev., 8: 325 pp.

Pauly D., 1980. A selection of simple methods for the assessment of tropical fish stocks. FAO Fish.Circ. (729)54p.

Pauly D., 1980. On the interrelationship between natural mortality, growth parameters and mean environmental temperature in 175 fish stocks. *J.Cons. CIEM*. **39**(2):175-192.

Relini G., Bertrand J., Zamboni A. (eds). 1999. Sintesi delle conoscenze sulle risorse da pesca dei fondi del Mediterraneo centrale (Italia e Corsica). *Biol. Mar Medit*., **6** (suppl. 1).

Relini G., Cima C., Garibaldi F., Calandri G., Relini M., Torchia G. 1996. Una risorsa costiera: il rossetto Aphia minuta mediterranea – De Buen, 1931 (Osteichthyes: Gobidare). *Biol. Mar Medit*., **3** (1): 205-213.

Relini G., Relini M. Torchia G. 1997. Reclutamento di specie ittiche su alcune barriere artificiali della Liguria. *Biol. Mar Medit*., **4**(1): 269-276.

Ria M., Silvestri R., Baino R. 2009 - Monitoraggio della pesca del rossetto (Aphia minuta) nelle acque della Toscana. 40° Congresso della Società Italiana di Biologia Marina, Livorno, 26-29 maggio 2009 (mimeo)

Sehity et al. 2005. Price developments after a nominal shock: Benford's Law and psychological pricing after the euro introduction. Intern. J. of Res. in Marketing 22: 471–480.

Serena F., Baino R., Voliani A. 1990. Distribuzione dei Triglidi (Osteichthyes, Scorpaeniformes) nell'Alto Tirreno. *Oebalia* suppl., **16**(1): 269-278.

Stein, B., & Meyer zu Eissen, S. - 2005. Near similarity search and plagiarism analysis. Proc. Of GfKl '05. Springer.

Tortonese E. 1975. Fauna d'Italia Osteichthyes. Calderoni Ed. Bologna, 11: 636 pp.

Tunesi L., Mariani L., Mori M. 1997. Insediamento di stadi giovanili di specie ittiche nelle acque costiere del Golfo del Tigullio (Mar Ligure). Biol Mar Medit., 4(1): 282-290.

Ungaro N., Casavola N., Marano G., Rizzi E. 1994. "Bianchetto" and "rossetto" fry fisheries in the Manfredonia Gulf: effort exerted and catch composition. Oebalia 20:99-106.

ALTRA BIBLIOGRAFIA DI RIFERIMENTO

Abaunza P., A.C. Farina & P. Carrera, 1995. Geographic variations in sexual maturity of the horse mackerel Trachurus trachurus, in the Galician and Cantabrian shelf. *Sci. Mar*., **59**(3-4):211-222.

Anon., 1984. Indagine sulla pesca del bianchetto. Relazione finale. Laboratorio Biologia Marina e Pesca di Fano per Min.Mar.Merc. Dir.Gen.Pes.Mar. 33+21p.

Astraldi M., Bacciola d., Borghini M., Dell'Amico f., Galli G., Gasparini G.P., Lazzoni E., Neri P.L., 1993. Caratteristiche stagionali delle masse d'acqua nell'Arcipelago Toscano. - Arcipelago Toscano. Studio oceanografico, sedimentologico, geochimico e biologico. ENEA. 7-27.

Auteri R., A. Abella, R. Baino, F. Serena, 1989. Criteri gestionali applicati alla pesca del Rossetto (Aphia minuta) nel Tirreno settentrionale. Rapporto Ministeriale, 56p.

Auteri R., A. Abella, R. Baino, F. Serena, 1992. La pesca del Rossetto (Aphia minuta) in Toscana. Stagioni di pesca 1990-91 e 1991-92. Rapporto Ministeriale. 65p.

Bagenal T.B., 1973. Fish fecundity and its relations with stock and recruitment. *Rapp. Reun. Cons. Int.Explor.Mer*., **164**:186-198.

Bhattacharya C.G., 1967. A simple method of resolution of a distribution into Gaussian component. *Biometrics* **23**:115-135.

Brethes J.C., O'Boyle R.N. (ed.), 1990. Methodes d'evaluation des stocks halieutiques. Projet CIEO-860060, Centre international d'exploitation des ocans, Halifax (Nouvelle-Ecosse, Canada), 963 pp.

Buzzichelli S., Cavalieri S. e Ceccatelli G., 1993. Lo stato trofico del litorale Apuo-Versiliese-Pisano. - Progetto Mare. Ricerca sullo stato biologico chimico e fisico dell'Alto Tirreno Toscano. Regione Toscana, Università di Firenze: 529-617.

Camiñas, J.A., Martorell, J.M. (1991) "Informe de la mesa de trabajo sobre la problematica de la explotación pesquera de góbidos y afines en el litoral mediterráneo español" Inf. Tecn. Inst. Esp. Oceanogr. 98: 1-61

Caputo, V., Candi, G., La Mesa, M., Arneri, B. (2000) "Pattern of gonad maturation and the question of semelparity in the paedomorphic goby *Aphia minuta* " *J. Fish Biol*. 58: 656-669

Caputo, V., Caniglia, M.L., Machella, N. (1999) "The chromosomal complement of Aphia minuta, apaedomorphic goby" J. Fish Biol. 55: 455-458

Caputo, V., G. Candi, E. Arneri, M. La Mesa, C. Cinti, M. Provinciali, P. Nisi Cerioni and A. Gregorini. – 2002. Short lifespan and apoptosis in *Aphia minuta*. J. Fish Biol., 60: 775-779.

Chesalin, M.N., G.V. Zuev and T.L. Chesalina. – 2004. Transparent goby *Aphia minuta* (Gobiidae) in the pelagic zone of the Black Sea. *J. Ichthyol*., 44: 587-591.

Clark, W.G., 1991. Groundfish exploitation rates based on life history parameters. *Can. J. Fish. Aquat. Sci*. **48**:734-750.

Condrey, R.E., 1984. Density-dependent searching time implications in Surplus-production models. *Fish. Bull*. **82**, No.3.

Crecco, V. & W. J. Overholtz, 1990. Causes of Density-Dependent Catchability for Georges Bank Haddock Melanogrammus aeglefinus. *Can. J. Fish. Aquat. Sci*.,Vol.**47**,: 383-394.

Del Mancino F., Marzi A. e Cepellotti R., 1993. Studio idrologico nell'area marina della Toscana Settentrionale tra Bocca di Magra e Calambrone. - Progetto Mare. Ricerca sullo stato

biologico chimico e fisico dell'Alto Tirreno Toscano. Regione Toscana, Università di Firenze. 489-528.

Farrugio H. e Quignard J.P., 1973. Biologie de Mugil (Liza) ramada Risso, 1826 et de Mugil (Chelon) labrosus Risso, 1826, (Poissons, Teleosteens, Mugilides) du lac de Tunis. Taille de premier maturit sexuelle, cycle et fecondite. *Bull. Inst. Nat. Scient. Tech. Oceanogr. Peche Salamb*, **2**(4):565-578.

Fisher W., M.L.Bauchot & M. Schneider (red.), 1987. Fiches FAO d'identification des espces pour les besoins de la peche (revision 1). Mediterranee et Mer Noire. Volume II, Rome, FAO, **2**:761-1530.

Fox W.W., 1970. An exponential surplus yield model for optimizing exploited fish populations. *Trans. Am. Fish Soc*. **99**:80-88.

Froglia C., 1980. Risultati preliminari della ricerca biologica e possibilità di pesca del Rossetto Aphia minuta. Rapporto Ministeriale. p. 6.

Gordoa, A. & J. E. Hightower, 1991. Changes in Catchability in a Bottom-Trawl Fishery for Cape Hake (Merluccius capensis). *Can. J. Fish. Aquat. Sci*.,Vol.**48**:1887-1895.

Hilborn, R. & C. J. Walters, 1992. Quantitative Fisheries Stock Assessment. Choice, Dynamics & Uncertainty. Chapman & Hall:563.

Hoaglin D.C. & R.E. Welsch, 1978. The hat matrix in regression and ANOVA. *Amer. Stat*., **32**:17-22.

Holden, S & M. V. Bravington, 1992. The CEDA package user manual. MRAG, London: 90.

Iglesias M. & J. M. Martorell Torres, 1992. La pesqueria de Gobidos en las Islas Baleares. *Inf. Tc. Inst. Esp. Oceanogr*., **116**:18 p.

Iglesias M., B. Morales-Nin, 1992. Fishery and Growth of *Aphia minuta* off Majorca Island. *Rapp. Comm. int. Medit*., **33**.

Iglesias M., E. Massut & B. Morales-Nin, 1992. Datos biologicos de dos especies (Aphia minuta e Coryphaena hippurus) capturadas estacionalmente en Mallorca. *Historia Natural* '91. Alemany Ed. 351-359.

Iglesias M., J. Miguel & F. Alvarez, 1995. Acoustic estimation of volume and distribution of *Aphia minuta* (Pisces, Gobidae) in Alicuda Bay (Mayorca Island, Spain). *Rapp. Comm. int. Medit*., **34**:246.

Iglesias, M. and B. Morales-Nin. – 2001. Life cycle of the pelagic goby *Aphia minuta* (Pisces: Gobiidae*). Sci. Mar*., **65**: 183-192.

Johansen A.C., 1924. On the summer and autumn spawning herring of the north sea. Medd. Fomm.

Ha Vunders Sea, *Fish. Bol*. VI.**5**.

Kartas F. et J.P. Quignard, 1984. La fcondit des poissons tlostens. Collention de Biologie des Milieux Marins. Masson Ed. Paris, 121p.

La Mesa M., 1999 - Age and growth of *Aphia minuta* (Pisces, Gobiidae) from the central Adriatic Sea. Sci. Mar., 63 (2): 147-155

La Mesa, M., E. Arneri, V. Caputo and M. Iglesias. – 2005. The transparent goby, *Aphia minuta*: review of biology and fisheries of a paedomorphic European fish. Rev. Fish Biol. Fisheries, 15: 89-109.

Leslie P.H. & D.H.S. Davis, 1939. An attempt to determine the absolute number of rats in a given area. *J. Anim. Ecol*., **8**:94-113.

Lopez Jaime, J.A., Escalante Blanque, P., Rodriguez Garcia, R., Zurita Escobar, F. (2000) "Experimental culture of *Aphia minuta*. Study on the maintenance in captivity, nutritional requirements, ecological needs and possibility of controlled reproduction" Cah. Options Medit. 47: 343-347

Mac Call, A. D., 1976. Density-dependence of catchability corfficient in the California Pacific sardine Sardinops sagax caerulea purse-seine fishery. CalCOFI Rep.,**18**: 136-148.

Mace, P. & M. P. Sissenwine, 1993. How much spawning per recruit is enough? (In) S.J.Smith, J.J.Hunt & D.Rivard (eds) Risk evaluation and biological reference points for fisheries management. *Can. Spec. Publ. Fish. Aquat. Sci*.,**120**: 101-118.

Mancini L., Geminiano Cavinato P. 1969. Osservazioni morfologiche e biometriche sul gobidae *Aphia minuta* nell'Adriatico Centrale e alcune considerazioni in rapporto alla pesca. *Boll. Pesca Piscic. Idrobiol*., **24**: 49-60.

Martinez-Bano P., Vizuete F. & Mas J., 1993. The fishery of transparent goby, *Aphia minuta* (Risso, 1810) on the fishing grounds off Murcia (southeastern Spain). Sci.Mar., **57**(2-3):199-205.

Martinez-Bano P., Vizuete F., Mas J. Y., Faraco F., 1990. Biology and fishing of *Aphia minuta* (Risso, 1810) in the S.E. of the Iberian Peninsula. (mimeo) 9p.

Mc Gregor E.A. 1922. Observations on the eggs yield of Klamoth River king salmon. *Calif. Fish. Gam*., **8**:160-164. 63

Method R.E. & D. Kramer, 1979. Growth of northern anchovy. *Engraulis ecrasicholus* larvae in the sea. *Fish. Bull*., **77**:413-421.

Morales-Nin B. 1992. Determinacion del crecimiento de peces oseos en base a la microestructura de los otolitos. FAO Doc.Tec. de Pesca. 322.

Murphy, E. J.; P. G. Rodhouse & C. P. Nolan, 1994. Modelling the selective effects of fishing on reproductive potential and population structure of squid- *ICES J. Mar. Sci*., **51**: 294-313.

Paloheimo, J. E. & L. M. Dickie, 1964. Abundance and fishing success. Rapp.R.V. Run. *Cons. Int. Explor. Mer*. **155**: 152-163.

Pauly, D. & N. David. 1981. ELEFAN I, a BASIC program for the objective extraction of growth parameters from length frequency data. *Meeresforsch*. **28** (4): 205-211

Pella J.J. & P.K. Tomlinson (1969). A generalized stock productioon model. *Bull.Inter-Am.Trop.Tuna Comm*. **13**:419-496.

Piccinetti C., 1982. Indagine sulla pesca del Bianchetto. Rapporto Ministeriale. 71p.

Pope, J.G. & D. J. Garrod, 1975. Sources of error in catch and effort quota regulation with particular reference to variation in the catchability coefficient. Int. Comm. Northwest. *Atl. Fish. Res. Bull*. **11**: 17-30.

Re P., 1994. Aneis diarios de crescimento nos otolitos dos estadio larvares dos pexes: prospettivas en biologia pesquera. Museu Bocage, Lisboa. 1994, 97-124.

Relini Orsi L. & G. Fanciulli, 1977. Prima segnalazione di Cristallogobius linearis in mar Ligure ed identificazione dei "bianchetti di fondo" di Portofino. *Natura-Soc.ital.Sci. nat., Museo civ. Stor. nat. e Acquario civ., Milano*. **68**(1-2):111-122.

Relini, G., Palandri, G., Relini, M., Garibaldi, F., Torchia, G., Cima, C., Massaro, B., Piccone, A., Bellingeri, M. (1998) "Pesca sperimentale del rossetto in Liguria" Biol. Mar. Medit. 5: 487-502

Riedl. R., 1991. Fauna e flora del Mediterraneo. F. Muzzio Ed. 777p.

Rojo A.L., 1985. Osteologa del chanquete, Aphia minuta (Risso, 1810) (Pisces: Gobiidea). *Bol. Inst. Esp. Oceanogr*., **2**(1): 165-179.

Rosemberg, A. A. ; G. P. Kirkwood; G. P. Crombie & J. A. Beddington, 1990. The assessment of stocks of annual squid species. *Fish. Res*. **8**: 335-350.

Rosemberg, A. A. ; G. P. Kirkwood; R. M. Cook & R. A. Myers, 1992. Combining information from commercial catches and research surveys to estimate recruitment: a comparison of methods. *ICES J. mar. Sci*., **49**: 379-387.

Samame M., 1971. Observacion de la madurez sexual y desove de la cachema. Cynoscion Annalis J. del Paita. Inf.Exp. Imp-81, IMARPE, Peru.

Schaefer M.B. 1954. Some aspects of the dynamics of populations important to the management of commercial marine fisheries. *Bull.Inter-Am.Trop.Tuna Comm*. **1**(2):27-56.

Serena F., R. Auteri, A. Abella, R. Baino, 1990. The Transparent Goby Fishery in the Northern

Tyrrhenian Sea. *Rapp. Comm. int. Medit*., **32**, 1. 257.
Soljan T., 1975. I pesci dell'Adriatico. A.Mondadori Ed. 523p.
Sparre P., 1989. Computer Programs for fish stock assessment (LFSA) for Apple II computers. FAO Fish. Tech. Pap. (101): suppl. 2: 218.
Thompson, W.F. & H. Bell. 1934. Biological Statistics of the Pacific halibut fishery.2. Effect of changes in intensity upon total yield per unit gear. *Rep. Internat. Fish. Comm*, No.8.
Trisolini R., E. Caniglia & R. Rossi, 1992. Pattern di crescita giornaliera in otoliti di avannotti di Liza ramada Risso e Liza saliens Risso Fry. *Oebalia* Suppl. XVII:229-230.
Von Bertalanffy L. 1938. A quantitative theory of organic growth. *Hum.Biol*. **10**:181-213.

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ALFONSO ANDRIANI, *redattore*
DELIA CHIARA, *vice redattore*

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